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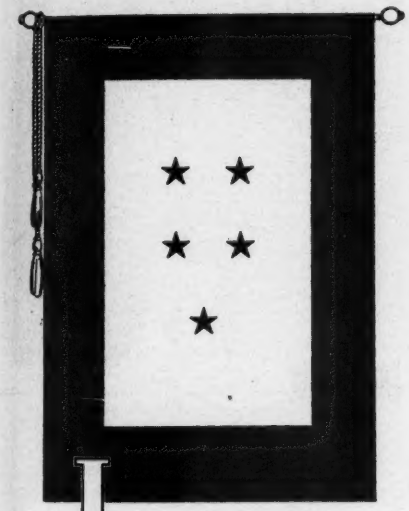

In the service of our country

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WALTER C. MONROE President and Editor
KINZIE MILLER Vice President

V. W. HEINZERLING, Manager California Oil World News Service and California Oil World Reference Edition

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April 27, 1943

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15,000 POUNDS

TEST PRESSURE?

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Administrative Highlights •

PAW Issues Supplementary Order No. 4 to PAO 11

TITLE 32—NATIONAL DEFENSE

CHAPTER XIII—PETROLEUM ADMINISTRATION FOR WAR

PART 1515—PETROLEUM PRODUCTION OPERATIONS

Supplementary Order No. 4 To Petroleum Administrative Order No. 11 As Amended April 19, 1943

General Exception Pursuant to Paragraph (c) (10) of Petroleum Administrative Order No. 11

Section 1515.10 Supplementary Order No. 4 to Petroleum Administrative Order No. 11:

(a) **Scope of this Order.**

Except as otherwise modified by the provisions of any other Order issued as a supplement to Petroleum Administrative Order No. 11 or by the provisions of any exception issued pursuant to paragraph (c) (10) of Petroleum Administrative Order No. 11, the provisions of this Order shall, to the extent provided herein, be applicable to production operations in the fields and pools of the State of California specified in Exhibit "A", but not elsewhere.

(b) **Definitions.**

The definitions of Petroleum Administrative Order No. 11 shall apply in this Order. In addition:

(1) "Designated Area" means the pools specified in Exhibit "A" of this Order.

(2) "New Well" means an oil well spudded subsequent to April 22, 1943.

(3) "Rework" means to perforate, plug back, deepen, redrill, clean out or otherwise rework an existing well in that pool from which such well is producing or last produced but excluding redrilling from a point more than 500 feet above such pool.

NOTICE

From now on all California operators shall direct all communications to the Petroleum Administration for War, Subway Terminal Building, Los Angeles.

(c) **New Well Drilled in the Designated Area.**

Pursuant to paragraph (c) (10) of Petroleum Administrative Order No. 11, any person may accept delivery of, acquire, or use material to drill, complete, equip, and connect any new well in the designated area: **Provided,** that:

(1) such well is drilled to and completed in a pool specified in Columns Nos. 3 and 4 of Exhibit "A" of this Order opposite the name of the field in which such pool is located; and

(2) such well is not drilled to a vertical depth greater than the depth specified in Column No. 5 of Exhibit "A" of this Order opposite the name of the pool to which such well is drilled; and

(3) such well is not completed in more than one pool; and

(4) such well is drilled, with respect to the pool in which it is to be completed, in conformity with the uniform well-spacing provisions contained in paragraph (d) of this Order of at least the size prescribed for such pool in Column No. 6 of Exhibit "A": **Provided,** that where no uniform well-spacing is prescribed in Column No. 6 of Exhibit "A" for a pool, the provisions of paragraph (c) of this Order shall not extend to such pool; and

(5) all separate property interests in the drilling unit on which such well is drilled are first consolidated with each other; and

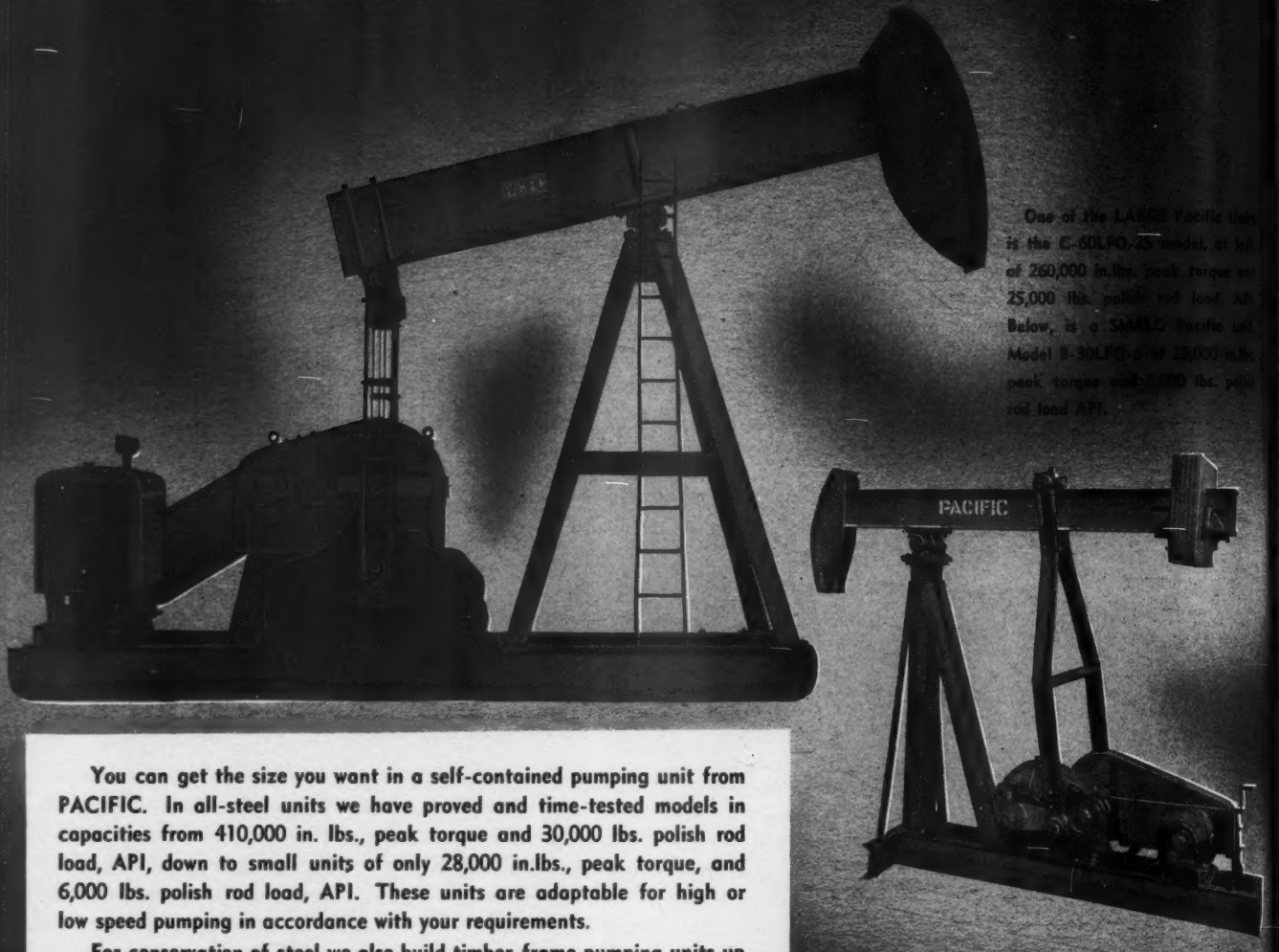
(6) the direct linear distance between any two points which are farthest removed from each other on the drilling unit upon which such well is drilled does not exceed the length of the diagonal of a rectangle, the length of which is twice its width and which is equivalent in surface acreage to such drilling unit; and

(7) if such well is intentionally deviated from the vertical

(i) the surface location of such well shall be deemed to be the point at which the vertical projection of the bottom of the well bore intersects the surface, and

(ii) two copies of a true and correct subsurface directional survey of its well bore shall be filed with the District Director of Production, District No. Five, within 30 days after the completion of such well.

LARGE OR *SMALL* PUMPING UNITS



One of the LARGE Pacific Units is the C-60LFO-25 model, at left, of 260,000 in.lbs. peak torque and 25,000 lbs. polish rod load, API. Below, is a SMALL Pacific unit Model B-30LFO-6 of 28,000 in.lbs. peak torque and 6,000 lbs. polish rod load API.

You can get the size you want in a self-contained pumping unit from PACIFIC. In all-steel units we have proved and time-tested models in capacities from 410,000 in. lbs., peak torque and 30,000 lbs. polish rod load, API, down to small units of only 28,000 in.lbs., peak torque, and 6,000 lbs. polish rod load, API. These units are adaptable for high or low speed pumping in accordance with your requirements.

For conservation of steel we also build timber frame pumping units up to 15,000 lbs. polish rod load.

Every unit, steel or timber, is equipped with the dependable PACIFIC herringbone, gear reducer and PACIFIC safety brake for safe operation.

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(d) **Uniform Well-Spacing.**

(1) Uniform 5 acre well-spacing. Each new well drilled pursuant to paragraph (c) of this Order shall conform to "uniform 5 acre well-spacing" only where:

(i) With respect to the pool to which such well is drilled,

(a) such well is drilled on a drilling unit of not less than 5 surface acres, no portion of which is attributable to or falls within 200 feet of any other drilling or producible oil well located on the same lease or property; and

(b) such well is drilled at least 400 feet from every other drilling or producible oil well; and

(c) such well is drilled at least 200 feet from every lease line, property line, or subdivision line which separates unconsolidated property interests.

(2) Uniform 10 acre well-spacing. Each new well drilled pursuant to paragraph (c) of this Order shall conform to "uniform 10 acre well-spacing" only where:

(i) With respect to the pool to which such well is drilled,

(a) such well is drilled on a drilling unit of not less than ten surface acres, no portion of which is attributable to or falls within 250 feet of any other drilling or producible oil well located on the same lease or property; and

(b) such well is drilled at least 500 feet from every other drilling or producible oil well; and

(c) such well is drilled at least 300 feet from every lease line, property line or subdivision line which separates unconsolidated property interests.

(3) Uniform 20 acre well-spacing.

Each new well drilled pursuant to paragraph (c) of this Order shall conform to "uniform 20 acre well-spacing" only where:

(i) With respect to the pool to which such well is drilled,

(a) such well is drilled on a drilling unit of not less than 20 surface acres, no portion of which is attributable to or falls within 300 feet of any other drilling or producible oil well located on the same lease or property; and

(b) such well is drilled at least 800 feet from every other drilling or producible oil well; and

(c) such well is drilled at least 300 feet from every lease line, property line or subdivision line which separates unconsolidated property interests.

(4) Uniform 40 acre well-spacing. Each new well drilled pursuant to paragraph (c) of this Order shall conform to "uniform 40 acre well-spacing" only where:

(i) With respect to the pool to which such well is drilled,

(a) such well is drilled on a drilling unit of not less than 40 surface acres, no portion of which is attributable to or falls within 300 feet of any other drilling or producible oil well located on the same lease or property; and

(b) such well is drilled at least 990 feet from every other drilling or producible oil well; and

(c) such well is drilled at least 300 feet from every lease line, property line, or subdivision line which separates unconsolidated property interests.

(e) **Computation of Attributable Acreage.**

(1) The acreage attributable to any well spudded on or before December 23, 1941, shall be determined by assigning to such well an acreage equivalent to that in the existing well density or well-spacing contiguous to such well, but not greater than that provided in Exhibit "A" for a new well to the same pool in which such well is completed.

(2) The acreage attributable to any well spudded subsequent to December 23, 1941, shall be the same as the drilling unit assigned to such well pursuant to Conservation Order M-68,, any Supplementary M-68 Order, any exception issued pursuant to a determination under Conservation Order M-68, or pursuant to Petroleum Administrative Order No. 11, any Order issued as a supplement to Petroleum Administrative Order No. 11, or any exception issued in response to an application filed as provided by paragraph (j) of this Order (whichever is applicable).

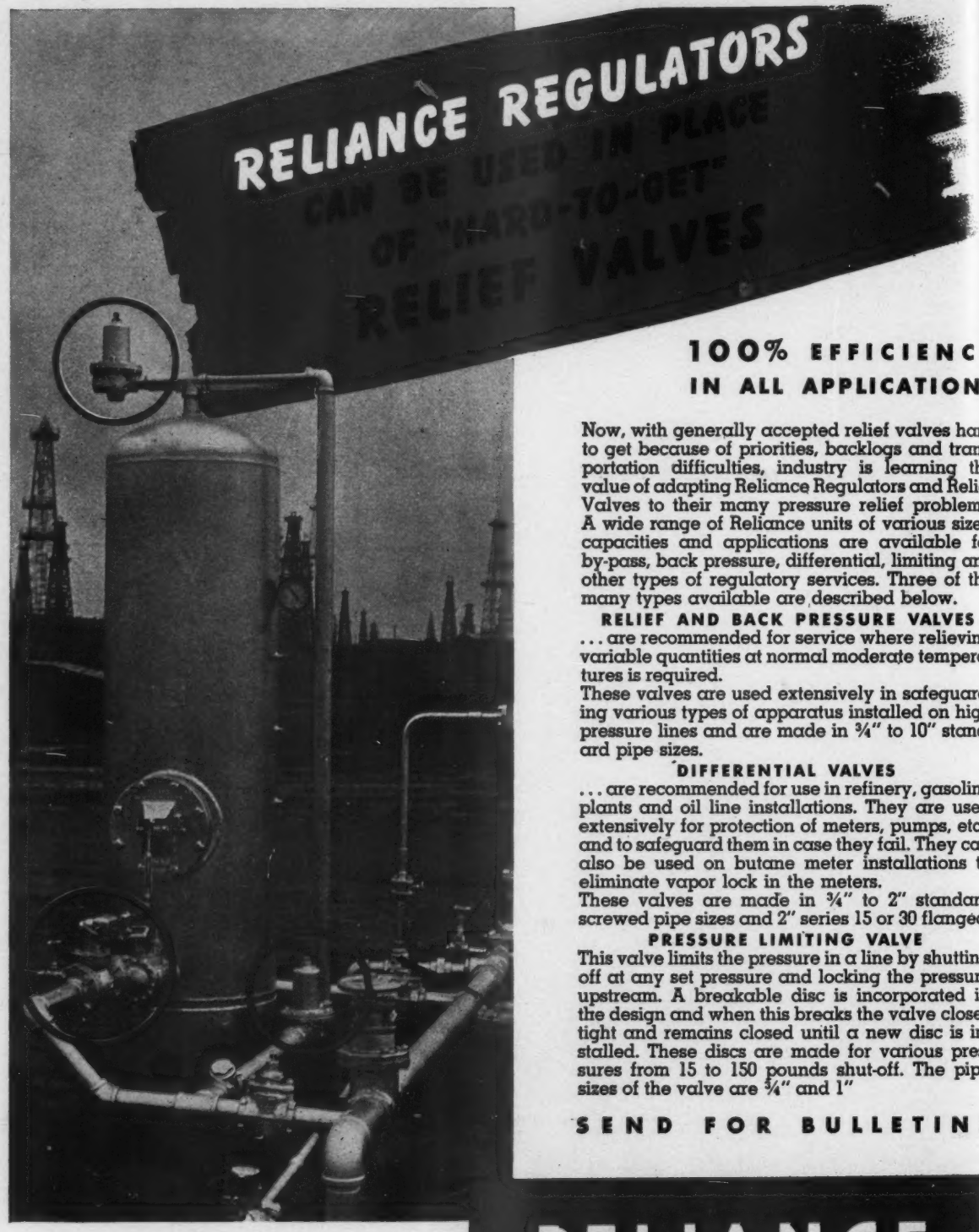
(f) **Rework of Well in the Designated Area.**

Pursuant to paragraph (c) (10) of Petroleum Administrative Order No. 11, any person may accept delivery of, acquire, or use material to rework (but not to deepen or plug-back from one pool to another) any oil well in the designated area: **Provided,** that with respect to the productive acreage within the pool in which such well is completed, the number of wells on any single lease or tract which are reworked subsequent to the date of this Order does not at any time exceed the average well density specified in Column No. 7 of Exhibit "A" opposite the name of the pool in which such well is completed. **Provided,** further, that where no well density is prescribed in Column No. 7 of Exhibit "A" for a pool, the provisions of this paragraph (f) shall not extend to such pool.

(g) **Restrictions on New Wells in Pools Designated "E" in Column**

Exhibit "A" follows on Pages 8a, 8b, 8c and 8d.

(Supplementary Order 4 continued on page 37)



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Now, with generally accepted relief valves hard to get because of priorities, backlogs and transportation difficulties, industry is learning the value of adapting Reliance Regulators and Relief Valves to their many pressure relief problems. A wide range of Reliance units of various sizes, capacities and applications are available for by-pass, back pressure, differential, limiting and other types of regulatory services. Three of the many types available are described below.

RELIEF AND BACK PRESSURE VALVES

... are recommended for service where relieving variable quantities at normal moderate temperatures is required.

These valves are used extensively in safeguarding various types of apparatus installed on high pressure lines and are made in ¾" to 10" standard pipe sizes.

DIFFERENTIAL VALVES

... are recommended for use in refinery, gasoline plants and oil line installations. They are used extensively for protection of meters, pumps, etc.; and to safeguard them in case they fail. They can also be used on butane meter installations to eliminate vapor lock in the meters.

These valves are made in ¾" to 2" standard screwed pipe sizes and 2" series 15 or 30 flanged.

PRESSURE LIMITING VALVE

This valve limits the pressure in a line by shutting off at any set pressure and locking the pressure upstream. A breakable disc is incorporated in the design and when this breaks the valve closes tight and remains closed until a new disc is installed. These discs are made for various pressures from 15 to 150 pounds shut-off. The pipe sizes of the valve are ¾" and 1"

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EXHIBIT "A"

COASTAL

(1)	(2)	Pool (3)	Pool (4)	(5)	Spacing & Well Density (6)	(7)	(8)
Field	County	Name of Pool	Formations Included in Pool	Vertical Depth Limit (Feet)	New Well (Acres)	Rework	Pumping or Other Artificial Lifting Equipment
Aliso Canyon	Los Angeles	Porter (Pliocene)	"P_1" to "P_{30}"		10	10	5
" "		Sesnon (Miocene)	"S-1" to "S-13"		E	20	10
Bardsdale	Ventura		All		20	5	5
Capitan	Santa Barbara	Vaqueros	Above Vaqueros-Sespe Contact		5	5	5
"		Sespe	Below Vaqueros-Sespe Contact	4,000	20	10	10
Casmalia	Santa Barbara	All Zones	Sisquoc and Monterey	3,500	20	5	5
Cat Canyon East and West	Santa Barbara	Sisquoc (Shallow)	Above Pliocene-Miocene contact		20	5	5
" " " " "		Las Flores	Monterey Chert	7,000	20	20	10
Del Valle	Los Angeles and Ventura	Sepulveda	"PS_1" to "PS_2"		20	20	10
" "		Vaquez-Videgain (Sherman)	"DV_1" to "DVI_4"		E	10	10
" "		Del Valle	"DD_1" to "DD_4"		20	10	10
" "		DL Zone	"DL_1" to "DL_3"		40	20	10
" "		Bering	"MB_1" to "MB_5"		40	20	10
Ellwood	Santa Barbara	Monterey	Above Top of Vaqueros		20	10	10
"		Vaqueros East and West	Between Top of Vaqueros and Top of Sespe		10	10	5
"		Sespe	Below Top of Sespe		E	10	10
Gato Ridge	Santa Barbara	Sisquoc (Shallow)	Above Pliocene-Miocene Contact		20	5	5
" "		Tognazzini	Monterey Chert	5,000	10	10	10
Holser Canyon	Ventura		Holser Zone		40	10	10
Hopper Canyon	Ventura		All	3,000	20	10	5
Lompoc	Santa Barbara	All Zones	Sisquoc and Monterey	3,500	20	10	10
Newhall-Potrero	Los Angeles	First, Second, and Third Zones	All	8,500	10	10	10
Oak Canyon	Los Angeles	Wickham	Above "K"		10	10	5
" "		Lechler	"L" to "L" plus 500'		20	20	10
Orcutt	Santa Barbara	First, Second, and Third Zones	All above base of Point Sal Sand	4,500	20	10	5
Oxnard	Ventura		All		20	10	5
Padre Canyon	Ventura		All	7,300	10	10	5
Rincon	Ventura	Top-Intermediate	Above Top of Miley Shale		10	5	5
"		Miley	First 2000' below top of Miley Shale		10	5	5
"		Deep	Below top Miley Shale plus 2000'		E	10	10
San Miguelito	Ventura	Grubb One	Above "K" plus 190'		10	10	5
Santa Barbara	Santa Barbara		All	2,500	20	5	5
Santa Maria Valley	Santa Barbara	All Zones	All above the Franciscan	6,000	E	10	5
Sespe Canyon	Ventura		All	3,500	20	5	5
Shiells Canyon	Ventura		All	3,500	20	5	5
Sisar-Silverthread	Ventura		All	3,500	20	5	5
South Mountain	Ventura		All	5,500	10	5	5
Temescal	Ventura		All	3,500	20	5	5
Torrey Canyon	Ventura		All	2,500	20	5	5
Ventura Avenue	Ventura	A-3, B-3	"AC" in the "A" Block or "X_2" in the "B" Block to "AP" in the "B" Block		10	10	10
" "		B-1, B-2	"P" to "X_2" in "B" Block		10	10	10
" "		B-4, B-5	"AP" to "DC" in the "B" Block		10	10	10
" "		C-1, C-2 West[a]	Taylor Thrust Fault to "AC" in the "C" Block		10	10	10
" "		C-3 West[a]	"AC" to "AS" in the "C" Block		10	5	5
" "		C-4 West[a]	"AS" to "DC" in the "C" Block		10	10	10
" "		C Block East[b]	Taylor 73 Fault to the Barnard Fault		5	2 1/2	2 1/2
" "		D-3	Barnard Fault to "AO" in the "D" Block		10	10	10
" "		D-4	"AO" to "AT" in the "D" Block		10	10	10
" "		D-5	"AT" to "DC" in the "D" Block		10	10	5
" "		D-6	"DC" to "DS" in the "D" Block		10	10	5
" "		D-7	Below "DS" in the "D" Block		E	40	10
Other Fields:							
Edna							
Elsmere Canyon							
Ex-Mission							
Huasna							
Lion Mountain							
Los Gatos							
Modelo			All Zones	3,500	20	5	5
Newhall							
Ojai							
Pico Canyon							
Pismo							
Sargent							
Simi							
Sulphur Mountain							
Summerland							
Tapo-Eureka							
Timber Canyon							
Tiptop Fresno Canyon							
Topa-Topa							
Wiley-Towsley Canyon							

a/ West of Taylor 99 Fault plane
b/ East of Taylor 99 Fault plane

LOS ANGELES BASIN

(1)	(2)	POOL (3)	POOL (4)	(5)	Spacing and Well Density (6)	(7)	(8)
Field	County	Name of Pool	Formations Included in Pool	Vertical Depth Limit (Feet)	New Well (Acres)	Rework	Pumping or Other Artificial Lifting Equipment
Alamitos Heights	Los Angeles	All	Above Base of McGrath Zone	7,200	20	2 1/2	2 1/2
Brea-Canyon	Orange and Los Angeles	Pliocene ("A" Sand)	Above Pliocene-Miocene Contact		10	2 1/2	2 1/2
" "		Miocene (Upper & Lower "8" Sand)	Miocene Contact to "AZ"	6,000	10	2 1/2	2 1/2
Buena Park	Orange		All		40	10	10
Coyote-East	Orange	Hualde-Anaheim or First Zone	Above "O" or Base of Union foraminiferal marker "8A"		10	2 1/2	2 1/2
" "		Second and Third Zone	"O" to "U"		10	5	5
" "		Stern or Fifth Zone	Below "U"	7,500	10	5	5
Coyote-West	Orange and Los Angeles	Upper and Main	Above "P"		20	5	5
" "		"99" Zone	"P" to "V"		20	5	5
" "		Emery	"V" to "AQ" plus 100'		10	5	5
Dominguez	Los Angeles	1st Zone	Above "AM"		10	5	5
"		2nd Zone	"AM" to AU"		10	5	5
"		3d,4th,and 8th	"AU" to base "CK" shale (Miocene Contact)		10	5	5
"		6th and 7th West Central Block c/	Base "CK" shale to base "CM"shale		20	5	5
"		8th West Central Block c/	Base "CM" shale to "DM" plus 100'		20	5	5
"		West Block Miocene Pool d/	Base "CK" shale to "DM" plus 100'		20	2 1/2	5
El Segundo	Los Angeles	Schist-Conglomerate	Top Nodular Shale to Schist	8,000	20	10	5
Huntington Beach New	Orange	Tar	All above Jones Sand		5	2 1/2	2 1/2
" " "		Jones	From point 300' above "AD" to "AM"		10	5	5
" " "		Main	Below "AM"	5,000	10	5	5
" " "		"A-37" Pool	TM_3 to TM_8 plus 100'		10	10	5
Huntington Beach Old	Orange	Bolsa-Area e/					
" " "		Bolsa	Above "M"		5	5	5
" " "		Upper Ashton	"M" to "U"		10	10	5
" " "		Lower Ashton	"U" to "U" plus 1000'		10	10	5
" " "		Balance East f/					
" " "		Bolsa	Above "M"		5	5	2 1/2
" " "		Ashton	Below "M"	5,000	10	5	2 1/2
Inglewood	Los Angeles	Vickers-Machado	Above "P"		5	5	2 1/2
"		Rindge	"P" to "AB"		5	5	5
"		Rubel	"AB" to "AG"		5	5	5
"		Sentous	First 600' below base of Nodular Shale		5	10	5
Long Beach	Los Angeles	Wilbur-Alamitos-Brown-Deep	Above "BA"		20	2 1/2	2 1/2
" "		De Soto	Below "BA"	10,600	5	5	5
Montebello	Los Angeles	Baldwin (1-4)	All Zones	5,000	10	2 1/2	2 1/2
"		West End (5-8)	Top of 5th zone shale through 8th zone	8,000	20	2 1/2	2 1/2
"		East End (Cruz-Nutt)	All Zones	7,500	20	5	5
Olinda	Orange	Pliocene	Above base of Pliocene basal conglomerate		10	2 1/2	2 1/2
"		Miocene	Below base of Pliocene basal conglomerate	5,500	10	2 1/2	2 1/2
Playa Del Rey-Venice	Los Angeles	Upper (Shallow)	Above top of Nodular Shale	5,000	20	2 1/2	2 1/2
" " " "		Deep (Conglomerate)	Top Nodular Shale to Schist	7,000	20	5	5
Potrero	Los Angeles		All	6,500	20	5	5
Richfield	Orange	Chapman-Kraemer	Below Chapman Shale	5,000	20	2 1/2	2 1/2
Rosecrans-Athens	Los Angeles	Athens Area					
" "		All Above Zins	All above top Zins Shale		20	5	2 1/2
" "		Zins	Top Zins Shale to top 7th Zone (O'Dea) Shale		20	5	5
" "		O'Dea	Top O'Dea Shale to Top 8th Zone Shale		20	5	5
" "		Rosecrans Area					
" "		Padelford-Maxwell	Top Padelford Shale to Top Hoge Shale		20	5	5
" "		Upper & Lower Hoge	Top of Hoge Shale to Top Upper Zins Shale		20	5	5
" "		Upper Zins	Top Upper Zins Shale to Top Lower Zins Shale		20	5	5
" "		Lower Zins	Top Lower Zins Shale to Top of 7th (O'Dea) Zone Shale		20	5	5
" "		7th (O'Dea)	Top of 7th Zone (O'Dea) Shale to Top 8th Zone Shale		20	5	5
" "		8th Zone	All below 8th Zone Shale	8,600	20	5	5
Santa Fe Springs	Los Angeles	Foix	Top Foix Shale to Top Bell Shale		20	5	5
" " "		Bell	Top Bell Shale to Top Meyer (M-1) Shale		20	2 1/2	2 1/2
" " "		Meyer	Top Meyer Shale to Top Nordstrom Shale		20	2 1/2	2 1/2

c/ Between Main Inglewood Shear Fault and the X Thrust Fault.
d/ West of X Thrust Fault.
e/ Area west and northwest of the common Signal-Standard "Bolsa" lease property line.
f/ Area east of the common Signal-Standard "Bolsa" lease property line.

(Continued on Page 8-D)

SAN JOAQUIN VALLEY.

(1)	(2)	POOL (3)	(4)	(5)	Spacing & Well Density (6)	(7)	(8)
Field	County	Name of Pool	Formations Included in Pool	Vertical Depth Limit (Feet)	New Well (Acres)	Rework	Pumping or Other Artificial Lifting Equipment
Antelope Hills	Kern	Williams	Above Lower Santos Shale	3,500	5	5	5
Belridge North	Kern	Shallow	Above top of Temblor		5	5	5
Belridge North		Temblor	"A" to "F"		E	10	10
" "		"R" Sand	"R" to "U"		E	20	10
" "		Wagon Wheel	"U" to Top Black Shale ("W" plus 500')		E	10	10
" "		"Y" Sand	Base Black Shale to "Y" plus 400'		E	20	10
Belridge South	Kern	Shallow	Above top of Belridge Diatomite Plus 200'		5	2 1/2	2 1/2
" "		Etchegoin	Top of Etchegoin plus 200' to top of Reef Ridge		5	2 1/2	2 1/2
" "		Deep	Top of Reef Ridge to Top of Temblor		10	5	5
Buena Vista Hills and Front	Kern	All Zones	Above base of Santa Margarita	5,000	10	5	5
Canal	Kern	Stevens	Above base Stevens Sand	8,500	20	20	10
Coalinga East	Fresno	Cretaceous	To base of Cretaceous Sand	3,500	20	5	5
" "		Temblor	Above top Kreyenhagen Shale	4,500	10	2 1/2	2 1/2
Coalinga Nose	Fresno	Gatchell	"EGA" to "EGZ"	3,500	20	10	10
Coalinga Northeast	Fresno	Gatchell	"EGA" to "EGZ"	8,500	E	10	10
Coalinga West	Fresno	Tar-Main	Above Top of Kreyenhagen Shale	3,500	5	2 1/2	2 1/2
Coffee Canyon Old and New	Kern	All Zones	To base Lower Vedder Sand	2,500	5	5	5
Coles Levee North	Kern	"21-1"	"N" plus 250' to "N" plus 550'		E	20	10
" " "		Western	"N" plus 350' to "N" plus 1500' exclusive of 21-1 Pool		E	20	10
Coles Levee South	Kern	Stevens	"N" to "N" plus 2,000'		E	20	10
Edison	Kern	East and West	Above Schist	5,000	10	10	5
Fruitvale	Kern	Martin-Kernco	Above base Lower Kernco Zone	5,000	10	2 1/2	2 1/2
Greeley	Kern	Stevens(Greeley)	Above "S" plus 500'		E	20	10
"		Rio Bravo-Vedder(11,2)	"RB" to base Lower Vedder Sand	11,600	20	20	10
Helm	Fresno				Condensate Field		
Jacalitos Anticline	Fresno	Temblor	Above top of Kreyenhagen Shale	5,000	20	10	10
Kern Front-Poso Creek	Kern	Kern Front-Premier	To base Chanac Formation	3,500	5	5	5
Kern River	Kern	Kern River	To base Kern River Formation	2,000	5	2 1/2	2 1/2
Kettleman North Dome	Kings and Fresno	Temblor (I-V Zone)	"A" to "S" plus 100'		E	20	10
" " "		Vaqueros (VI Zone)	"VA" to "KR"		20	20	10
" " "		Eocene	Below "MS"	11,500	E	20	10
Lost Hills	Kern	All Zones	To base Santa Margarita	3,500	5	2 1/2	2 1/2
McKittrick District	Kern	Cymric, McKittrick, McKittrick Front, Temblor Ranch, Southwestern Area)	Above top Reef Ridge (Santa Margarita)		5	2 1/2	2 1/2
Midway Sunset	Kern	H & T	Conglomeratic beds below the Etchegoin (Tulare) and above the true Maricopa Shale	3,500	5	5	5
" "		Republic	The Republic sands within the Upper 3000' of the true Maricopa Shale	3,500	5	5	5
" "		Quality	Productive sands within the upper 3500' of the true Maricopa Shale	3,500	5	5	5
" "		Lakeview	Productive sands at the base of the Etchegoin and in Upper Miocene	4,500	10	5	5
" "		Evans	Productive sands within the upper 2500' of the true Maricopa Shale	3,500	5	5	5
" "		Webster (Ruby)	Productive sands within the upper 3000' of the true Maricopa Shale	3,500	5	5	5
" "		Gibson	Productive sands within the Upper 1000' of the Miocene Shale	4,000	10	5	5
" "		Hoyt	Productive sands in the Transition Zone between Pliocene and Miocene	3,500	5	5	5
" "		15-19 D (Standard)	Undifferentiated Miocene Sands	4,500	10	10	10
" "		Main above 3500'	All productive sands not otherwise classified	3,500	5	2 1/2	2 1/2
" "		Main below 3500'	All productive sands not otherwise classified	5,000	10	2 1/2	2 1/2
Mt. Poso District	Kern	Baker,			5	5	5
" " "		Dominion,			5	5	5
" " "		Dorsey,			5	5	5
" " "		Dyer Creek,			20	5	5
" " "		McVan,	To base Lower Vedder Sand	3,500	20	5	5
" " "		Mt. Poso,			5	2 1/2	2 1/2
" " "		Mt. Poso East,			5	5	5
" " "		Mt. Poso North,			5	5	5
" " "		Mt. Poso West,			5	5	5
" " "		Sunset.			5	5	5
Mt. View District	Kern	Arvin,					
" " "		Northwest,	To base Santa Margarita	6,500	10	5	5
" " "		Southeast,					
" " "		Earl Fruit.					
Paloma	Kern				Condensate Field		
Panoche Creek	Fresno		All		40	20	10
Pleasant Valley	Fresno		All		40	20	10
Pyramid	Kern	Vedder	To base Lower Vedder Sand	2,600	5	5	5
Raisin City	Fresno		All		E	20	10

SAN JOAQUIN VALLEY

(1)	(2)	POOL (3)	POOL (4)	(5)	Spacing & Well Density (6)	(7)	(8)
Field	County	Name of Pool	Formations Included in Pool	Vertical Depth Limit (Feet)	New Well (Acres)	Rework	Pumping or Other Artificial Lifting Equipment
Riverdale	Fresno	Temblor	Above top Kreyenhagen Shale		E	20	10
"		Eocene	First 500' below bottom Kreyenhagen Shale		E	20	10
Rio Bravo	Kern	Rio Bravo-Vedder	To base Lower Vedder Sand	11,600	E	20	10
Round Mountain	Kern	Jewett	"J" to "T" (or top of Vedder Sand)		20	5	5
" "		Vedder	"T" to base Lower Vedder Sand		5	5	5
Strand	Kern	Upper (1 & 2 Zones)	Above "SS_2"		20	20	10
"		Lower (3 & 4 Zones)	"SS_2" to "SS_3" plus 200'	9,000	20	20	10
Strand East	Kern	Stevens	All Zones	9,000	40	20	10
Ten Section	Kern	Stevens	Above base Stevens Sand	9,000	E	20	10
Wasco	Kern	Vedder	To base Vedder Sand		40	20	10
Wheeler Ridge	Kern		All Zones	4,500	20	5	5
Other Fields:							
Arvin							
Blackwells Corner							
Canfield Ranch							
Chico Martinez							
Devils Den					20	10	5
Grapevine							
Pyramid Hills							
Shafter							
Terra Bella							
Union Avenue							

LOS ANGELES BASIN (Continued)

Column (1)	(2)	POOL (3)	POOL (4)	(5)	Spacing and Well Density (6)	(7)	(8)
Field	County	Name of Pool	Formations Included in Pool	Vertical Depth Limit (Feet)	New Well (Acres)	Rework	Pumping or Other Artificial Lifting Equipment
Santa Fe Springs	Los Angeles	Nordstrom	Top Nordstrom Shale to Top Buckbee Shale		20	5	5
" " "		Buckbee	Top of Buckbee Shale to Top of O'Connell Shale		20	5	5
" " "		O'Connell	First 990' below the top of the O'Connell Shale		20	5	5
" " "		Clark-Hathaway	Below Top of O'Connell Shale plus 990'	8,000	20	5	5
Seal Beach	Orange and Los Angeles	Bixby	Above Selover (60') Shale.		10	5	5
" "		Selover	Top Selover (60') Shale to Top Wasem (30') Shale		10	5	5
" "		Wasem	Top Wasem (30') Shale to "T"		10	5	5
" "		McGrath	Below "T"	7,000	20	10	5
Tonner Canyon	Orange	Miocene	All	5,500	5	5	2 1/2
Torrance-Hermosa-Redondo	Los Angeles	Shallow (Main)	Above base "I" Shale		10	2 1/2	2 1/2
Torrance-Hermosa-Redondo		Deep (D&B, 34, Flint, etc.)	From base of "I" Shale to Schist		20	2 1/2	2 1/2
Turnbull Canyon	Los Angeles	Clevenger	Top of "F" to bottom of "G"		10	10	5
Whittier District	Los Angeles	LaHabra, Rideout Heights, Bartolo and Central	All		20	2 1/2	2 1/2
Wilmington	Los Angeles	Block I g/					
"		Tar-Ranger-Upper Terminal	Above "AC"		5	2 1/2	2 1/2
"		Ford	"AM" to "AW" plus 80'		10	2 1/2	2 1/2
"		Blocks II, III, IV, and V h/					
"		Tar	"S" to "F"		10	5	5
"		Ranger	"F" to "HX"		5	2 1/2	2 1/2
"		Upper & Lower Terminal	"HX" to "AE"		5	2 1/2	2 1/2
"		Union Pacific	"AE" to "AM"		10	10	5
"		Ford	"AM" to "AW" plus 80'		10	5	5
Yorba Linda	Orange	Shell-Smith	Above Base of Pliocene	3,500	10	5	5
Los Angeles District	Los Angeles	Beverly Hills)					
" " "		Los Angeles)	All		E	5	2 1/2
" " "		Salt Lake)					
Other Fields	Los Angeles and Orange	Chino)					
" "		Kraemer)					
" "		Lawndale)			20	5	2 1/2
" "		Puente Hills)					
" "		Western Avenue)					

g/ Area West of Wilmington Fault Plane
h/ Area East of Wilmington Fault Plane

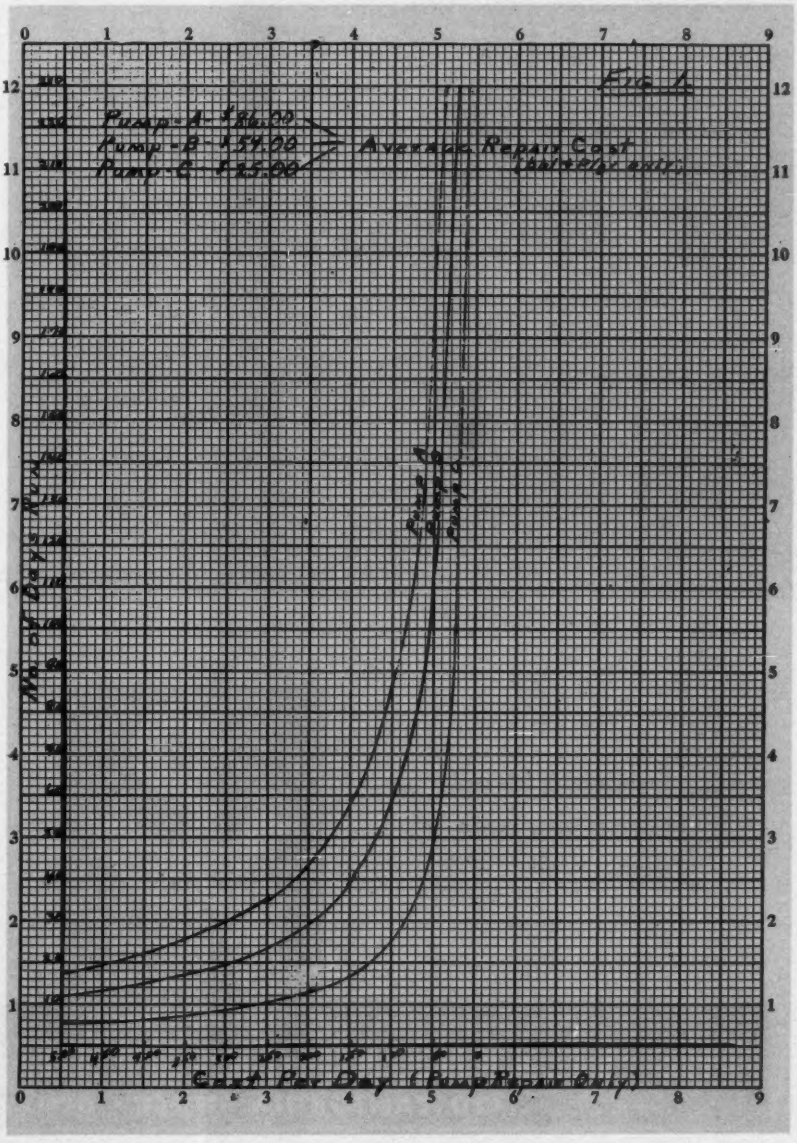
Pump Economics

By Grey Simpson

This is an article designed to discuss subsurface oil well pump costs and to justify purchases of the better quality pumps. First I should like to quote a phrase from "Clouds" book on petroleum engineering, "A close study of the causes of lost time at pumping wells supplies the prudent operator with a check on the **Cost** and **Stability** of the equipment made by any manufacturer and serves as a guide when future purchases are made". This is very well put and is the thing that any manufacturer of high quality equipment should welcome. "Lost time" at a pumping well is annoying and may often be quite expensive. Cloud again says, "60-75% of down time usually can be attributed to subsurface equipment". This of course will vary with depth, location, type of production to be handled and quality of equipment used. A large percentage of this 60-75% will be directly resulting from pump failures. This failure of sub-surface equipment brings up another cost item. That is pulling cost or well service costs. It should be noted here that it costs as much to pull and inspect a poor piece of equipment as it does a good one.

In my opinion the piece of subsurface equipment that has failed whether it be a pump, rods, tubing, etc., the pulling cost or service charge must be charged directly to that piece of equipment if a fair analysis is to be obtained. For example if a well is pulled for a pump failure (worn pump) and the pump was repaired at a cost of $60.00 it may have cost $40.00 to pull the well. Thus making a total cost of $100.00 to service the pump. This excludes the possibility that there were other sub-surface repairs made at the time that might absorb some of the pulling cost. Another pump may cost $80.00 to repair and have the same pulling cost of $40.00 making a service cost to the pump of $120.00 Now the problem is to determine which of these pumps, providing they were run in the same well **under the same conditions,** were the most economic for the operators. Referring to Figure #1 we see a curve setting forth the costs per day on three different grades of pumps based only on actual repair charges to the pumps*, so it is an easy matter to determine your cost per day per grade of pump, by simply finding days run on vertical line follow over to pump cost curve line, for the quality pump in mind, then down to cost per day line plotted horizontally. Hence in Figure #1 pump A for 60 days run cost $1.43 per day; pump B cost $.98 per day; and pump C cost $.42 per day. Now let's consider it from another angle. Take $.60 per day for an average cost per day per pump, in this case pump A would have to run 143 days; pump B 98 days; and pump C 42 days.

In figure #2 the curves were plotted as a function of pump repair cost plus pulling cost. ($40.00



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A Message to Recycling Plant Operators, and Natural Gas Manufacturers!

YOU, as well as we, are well aware that this ever-growing industry demands an ever-increasing program—plant enlargement to increase production of butanes and propane and super-fractionating equipment for more selective recovery of hydrocarbon fractions; also gas dehydration units to condition gas for pipe-line delivery, etc.

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—Natural Gasoline and Recycling Plants on a turnkey basis —in our usual complete manner, delivering them to our clients as complete units, operating at proper efficiency.

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Increase the life and value of your investment.

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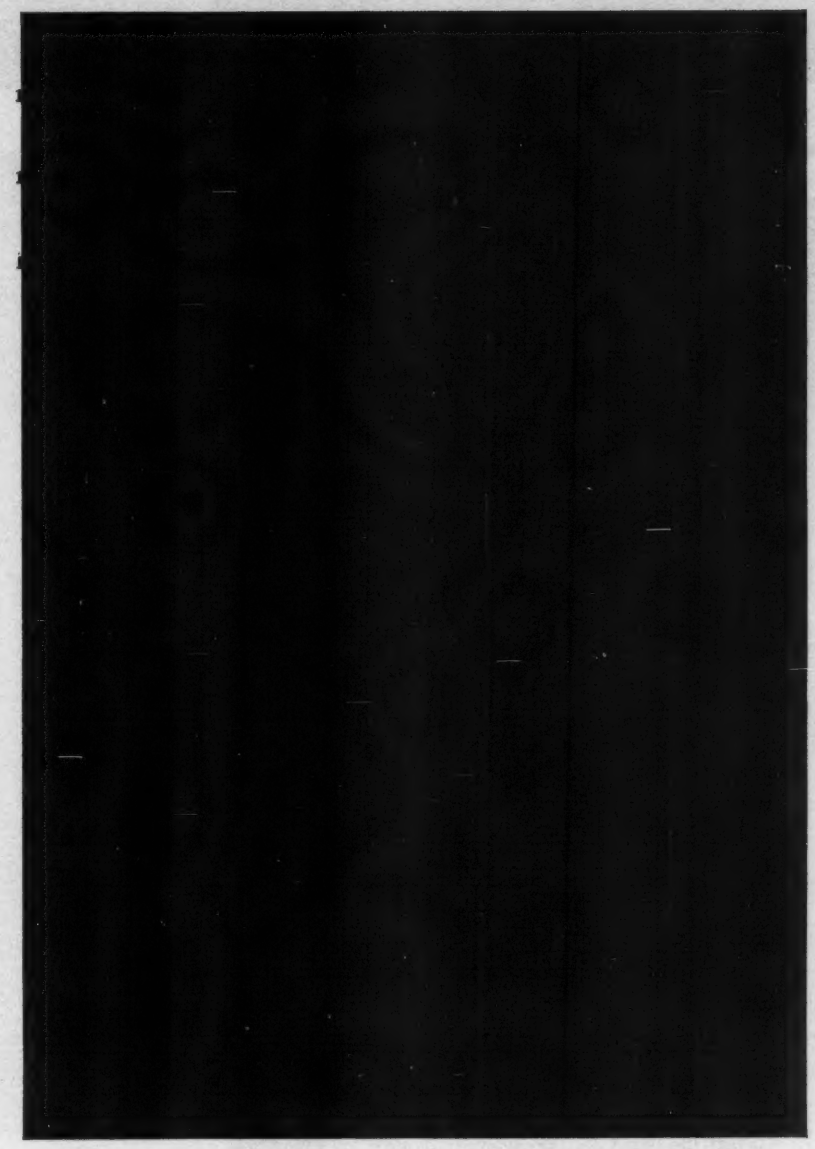
is again used for an average pulling cost). Now let us see what the cost per day will be for pump A, B, C, for the same 60 day run. Pump A $2.10 pump B $1.65 pump C $1.08. Now for an average cost (pump repair and pulling cost) of $1.00 per day, pump A must run 126 days, pump B 99 days, and pump C 65 days. Thus it is plainly seen when the pulling costs are considered that the grade A pump must only run twice as long as the grade C pump and 1⅓ times as long as the grade B pump to be equally as inexpensive to the operator plus the saving in man hours which is quite vital at the present time. From the authors experience, in a field where abrasion and, (or) corrosion are almost always present, pump A, in 85% of the installations, will outperform pump B from 3 to 1 and pump C from 8 to 1. This, however, is an average estimate and is still subject to trial in each individual well and the purchases should be judged from the performance in that well, but it does show that the grade A pump is apt to be the most economical.

It will be noticed that pump costs are plotted as so much per day instead of so much per barrel. Cost per barrel should really be used as one grade pump may pump more barrels per day under the same conditions than another and this would change the picture somewhat. This cost per barrel may easily be found by dividing daily cost by gross barrels per day produced. I have known instances where the grade A pump has produced enough more gross barrels per day to pay for the pump and pulling costs than the grade B pump under the same operating conditions. This of course is only of value when an operator is interested in obtaining maximum daily production and will not always hold true. It may be credited to a freer acting, better dropping pump.

*Repair charges in this case are repairs to barrel and plunger only as other repairs such as, balls and seats, etc., will be about the same for Grade A, B, C, Pumps.



When making these comparisons it is essential that they be made with the same size pump and under the same operating conditions such as speed, length of stroke, strokes per minute, and operating depth. It is quite possible to take a grade B pump, apply it properly and outperform a grade A pump which is improperly applied. This is true because there are three major factors that influence the life of a pump. 1. Well condition, 2. Application, 3. Grade of pump.

To elaborate on this further:

I. Well Condition
   1. Abrasives (course and, or, fine sand).
   2. Corrosion (electrolytic or Hydrogen sulfide).
   3. High Percentage of Water
   4. Heat
   5. All gravities of fluids
   6. Depth from 500 to 8000 ft.
   7. Large volumes of fluid
   8. Gas

II. Application
   1. Strokes per minute (In relation to type and amount of production to be lifted).
   2. Length of stroke (In relation to same as above).
   3. Volumetric efficiency
   4. Submergence

FIBROTEX

PREVENTS OR RESTORES LOST CIRCULATION IN GRAVELLY, FRACTURED OR CREVICED FORMATIONS

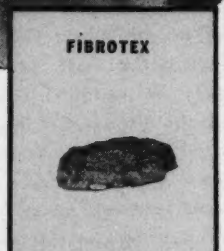
FIBROTEX is a scientifically prepared fibrous material which, when added to rotary drilling fluid, prevents or restores lost circulation. It takes the place of beet pulp, cottonseed hulls, straw, etc., and is especially effective in gravelly, fractured or creviced formations either before the thief formation is encountered or after circulation is lost. FIBROTEX-laden mud, by reason of its sealing ability, will often eliminate the necessity for a cement job.

Because fibers of uniform size are not sufficient to seal all formations, FIBROTEX is manufactured with both small and large fibers intimately mixed to meet all conditions successfully.

FIBROTEX is economical because it need not be added to all the mud in the system; a slug of the fiber-laden mud can be placed opposite the anticipated or encountered loose formation and may prevent all additional trouble.

FIBROTEX is non-abrasive and non-corrosive and can be kept in storage without deterioration. When mixed with mud, it can be held in reserve without losing its efficiency. FIBROTEX is furnished in paper-wrapped bales containing approximately 50 pounds. One bale will treat four barrels of mud and 50 barrels are generally sufficient for a single treatment. Should a seal be obtained before all the 50 barrels are used, the remainder may be stored for future use.

You can make hole faster, and at less expense, with FIBROTEX and other Baroid Products.



FILTER CAKES DEPOSITED ON A POROUS MEDIUM BY THREE FIBER-LADEN MUDS. Note comparative thinness of FIBROTEX cake on ¼" gravel at 3000 pounds per square inch. This illustrates its value in restoring circulation. Because of the thickness of the cottonseed hull and the beet pulp cakes they are more apt to be dislodged by the passage of tools than the FIBROTEX cake.

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5. Design (type of valves—spacing of valves—General Construction of Pumps).
6. Choice of metals best suited for job.

III. Grade of Pump
1. Materials used
2. Workmanship all important
3. Design

The above outline is very brief and is too large a subject to attempt to cover here, however it should give an idea of the things influencing pump application and its economic results.

The point to bring is, the grade A pump with proper application will prove to be the most economical installation in nearly all cases if an operator will base his costs on a per day or per barrel basis instead of the cost of each pump repair charge. Sometimes the margin is small and pulling or service cost must be considered to swing the balance, but if the records are complete the grade A pump will usually get the vote from the economic standpoint. There is the type of well however, that is easy on pumps therefore the payout for a grade A pump is slow because the investment is naturally higher than grade B or C and as this type of well rarely gives trouble, it is hard to convince a production man he needs a better pump. As a result of all this you will find the tough wells produced by grade A pumps, the medium well by grade B, and the easy wells by grade C. This is a rough average for California. However, many of the major oil companies particularly those who maintain their own pump shops have discarded the grade C pump almost altogether, because of its inferiority both in materials used and workmanship. The grade B pump, however, is still the most widely used in California, and is a good pump for an average pumping condition. Many wells that are now being pumped with grade B pumps could be pumped more economically with a grade A pump, since the cost

Fig 3. Lease - Smith Well # 10

Make & Type of Pump	Date Installed	Liner & Plunger Material	Gross Production Bbl/Day	Water & B.S.	Strokes Per Minute	Length of Stroke	Pump Efficiency (Approximate)	Repair Cost to Pump (Will fill in not pump/as between pump changes)	Pulling Cost (Average)	Days Run Or Total Bbls Produced Per Pump Change	Cost per Day Or Per Bbl (pump repair cost + pulling cost)	REMARKS Note all changes in pumping mechanism
2½x2½x7 Tubing Liner (Grade-B)	9/6/42	45° O.P. Plunger Hard Cast Liners	250	150	18	36	75%	3	$60	$40	90	$1.11	No Changes Pump sand cut.
2½x2½x7 Tubing Liner (Grade-A)		36° I.R. Metal Plgr. I.R. Metal Liners	250	150	18	36	75%	2	$56	$40	140	$.90	Changed from Grade B to Grade A. Ran 140 days. Cost per day dropped from $1.11 to $.90. No other changes.

is only about ⅓ more for the grade A pump, so with only this difference in cost it becomes a matter for records and the economies they show which brings us back to the first part of the article.

Good records are very simple and very cheap to keep unless an operator is making sub-surface changes frequently. In this case they must be quite detailed and are consequently more expensive. It is also harder to arrive at a conclusion where there have been frequent changes in application, as this many times will lengthen or shorten the life of a pump depending on what changes have been made.

A record might be kept as follows: See figure #3.

This should be all the information needed if it is kept up to date, and should give a sound economic answer for using any grade of pump regardless of make, type or tradename.

Pumps many times are bought through friendship, habit, or lack of knowledge as to their quality, but the fact remains that this method may often be quite expensive to the operator. There are many types, grades, and designs of pumps and each has its purpose or place. This purpose or place will be best shown by adequate cost per day or cost per barrel records.

The proper application using the proper grade of pump (materials, workmanship, and design) will be the most economical installation per day or per barrel.

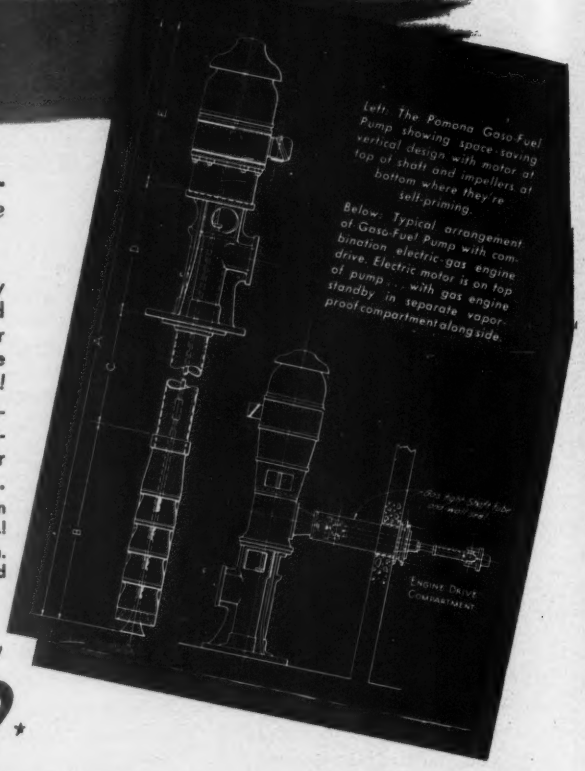
Aubert Elected Chairman Wildcat Committee

The members of the Wildcat Committee of the California Oil and Gas Association were the guests of Mr. L. L. Aubert, president of the Bankline Oil Company, at a dinner held in the California Club, Los Angeles, on Thursday evening, April 15.

The occasion was the induction of Mr. Aubert into the office of chairman of the Wildcat Committee for the year 1943-44. A feature of the evening's program was the presentation to the Red Cross of a substantial check from the Committee for its vital work. Other officers of the Committee are Al Gregerson, The Texas Company, vice-chairman; Wm. C. Brooks, Petroleum Equipment Company, treasurer; D. S. Kilgour, California Oil and Gas Association, secretary. The recent activities of the Wildcat Committee embraced the sponsorship of the Christmas Jinks of the California Oil and Gas Association for the benefit of the men of the Merchant Marine, which resulted in a check for $6,500 being turned over to United Seamen's Service, Inc.

The new Pomona Gaso-Fuel Pump...

Your solution to Aviation Refueling Problems!



Left: The Pomona Gaso-Fuel Pump showing space-saving vertical design with motor at top of shaft and impellers at bottom where they're self-priming.

Below: Typical arrangement of Gaso-Fuel Pump with combination electric-gas engine drive. Electric motor is on top of pump . . . with gas engine standby in separate vapor-proof compartment along side.

Particularly Recommended for Transfer Pumping of Underground Storage at Airfields, Base Storage Points, etc.

THERE has long been vital need for a pump specifically designed to meet the unique requirements of gasoline and fuel oil transfer pumping, airfield refueling systems, etc. After extensive research and development, Pomona engineers have perfected such a pump, *the Pomona Vertical Gaso-Fuel Pump!* This pump overcomes the many drawbacks of conventional-type units in gaso-fuel service and has been particularly engineered to insure safe handling of volatile liquids under hazardous conditions. A few of its unique features include . . .

Explosion-Proof Motor: Discharge heads designed for operation with totally enclosed *explosion-proof* motors, any size—2 to 75 h.p.!

Extremely Compact: Pump is of space-saving vertical construction. Even largest size requires only 25" diameter of floor space. Easily fitted to existing piping arrangements!

Self-Priming: The pump impellers are below fluid level and begin pumping the instant motor starts. No priming required . . . *an important safety feature!*

Handles 100 Octane: Unlike closed impeller pumps, Pomona's semi-open impellers eliminate the hazard of vapor locking on highly volatile fluids, aviation gasolines and similar fuels.

No Fuel Contamination: All bearings in fluid stream are lubricated *by the fluid being pumped.* No oil or grease chambers to leak . . . no risk of contaminating fuel supplies!

Vapor-Tight Packing Gland: There is only one packing gland in this pump (contrasted with the two or more needed in other-type pumps) and it is specially designed to handle volatile liquids without leakage.

Minimum Turbulence: Fluid flow through the pump is unusually smooth with minimum friction and turbulence. Eliminates pockets and traps where "gas lock" can occur . . . prevents volatilizing fuel!

THESE ARE ONLY A FEW of the many outstanding features incorporated in the new Pomona Gaso-Fuel Pump. Write our engineering department for assistance on adapting this pump to your particular fuel handling operations . . . whether for gasoline or oil, large gallonage or small, new construction or "work-over" operations!

THE POMONA GASO-FUEL PUMP brings a new standard of efficiency to the handling of gasolines, benzines, diesel fuels, oils and similar fluids stored in airbase or other refueling systems • It can be mounted directly on the top of sub-surface storage tanks or in other convenient locations for use in transferring fluids to various dispersal units, pumping to loading tanks, etc. • All flanges and mountings are drilled to fit standard openings in storage reservoirs now in common use, enabling the pump to be quickly installed in existing distribution systems without piping alterations . . . or to be installed in new construction without costly, time-wasting special designs • Intake can be set close to the bottom for quick clean-up of sumps, tanks or compartments, and guards are available to prevent picking up bottom sediment or water • Pump can be easily adjusted at the surface to fit varying capacities and head conditions, giving wide flexibility to fit the particular operating requirements of each installation.

Get the full story on this new Pomona Gaso-Fuel Pump. Find out how it increases the safety and efficiency of refueling systems . . . how it incorporates unique operating features available in no other make or type of pump available today! See your nearby Pomona dealer for complete details—or write direct to our engineering department!

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PUMPS

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Plants located at 4301 South Spring Avenue, St. Louis, Missouri, and 206 Commercial Street, Pomona, California

A PRODUCT OF THE WORLD'S LEADING TURBINE PUMP MANUFACTURER

Prediction of Suction Limitation When Pumping Volatile Liquids

Clark D. Bower
Assistant Chief Engineer
Perry H. Brown
Engineer
Joshua Hendy Iron Works
Pomona Pump Co. Division

April Meeting

Mr. Maas, Mr. Armstrong, Members of the C. N. G. A. and A. S. M. E.:

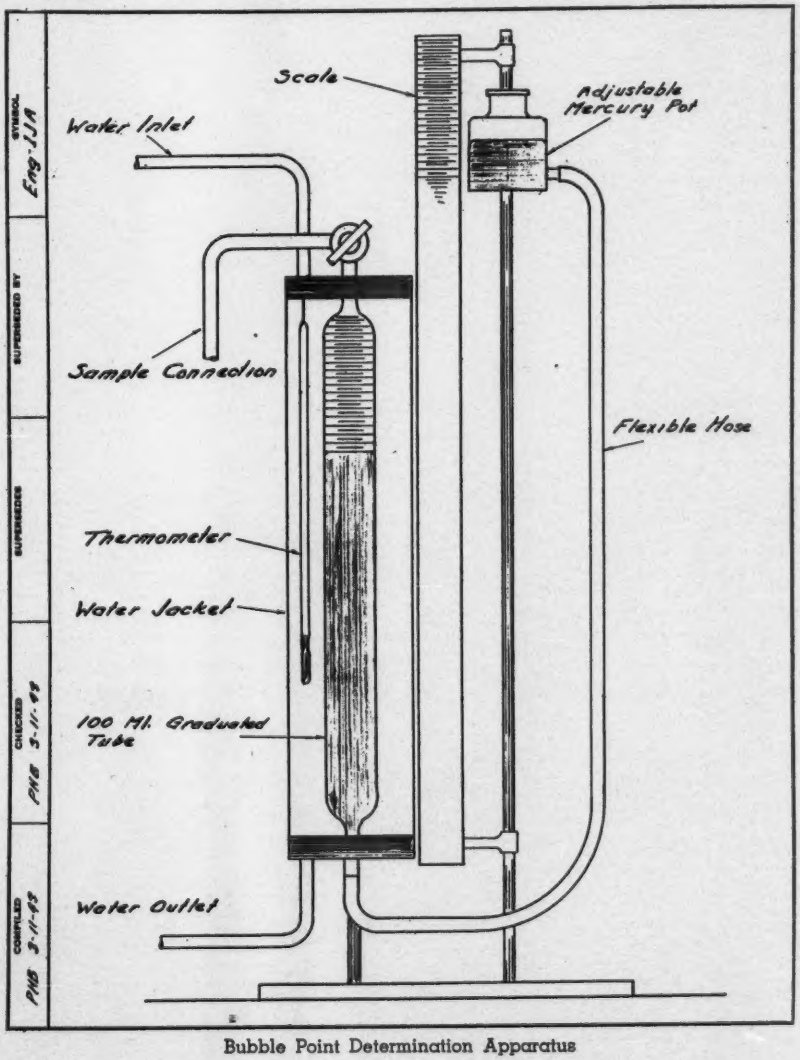
For a number of years I have enjoyed the security of sitting where you now sit and would undoubtedly feel a great deal more at home if I were in that position now.

The handling of gasoline by pump manufacturers who in the normal procedure of their business are concerned with the pumping of water is something relatively new and can be attributed primarily to the increased demand for aircraft to conduct the war. The preliminary study of the problem of pumping gasoline indicated that enough work had been done to accurately predict the performance of the pumping equipment as to head, capacity and horse power from previously known water performance. However, there seemed to be no published information on the suction limitations of such pumping equipment when handling gasoline.

The Pomona Pump Company decided that tests to obtain the cavitation characteristics of pumps pumping gasoline were in order and if these tests could be properly correlated through the vapor characteristics of the fuel to be pumped to the water cavitation characteristics, it would then be unnecessary to test each pump in gasoline. Our first objective of testing one pump in gasoline was relatively simple and was conducted in the usual manner of obtaining the suction limitations for various head, capacity and speed conditions. This information was obtained in the same test set-up for both 100 octane gasoline and for water.

The test set-up consisted primarily of a re-circulation system where a storage tank of 800 gallons was connected to the suction of the pump. The discharge head was obtained by throttling, the capacity measured by a venturi meter, and the suction head which could be varied from positive to negative gage values was measured by a mercury U tube. Power input to a calibrated motor was obtained by an indicating wattmeter which aided materially in the detection of cavitation. Temperature control was obtained by cooling the tank, and readings of the temperature of the fluid were taken at regular intervals in pump suction. For purposes of safety this test was conducted in an orange grove and slides of the set-up are to be shown later.

For purposes of discussing the results, it becomes necessary to refer to suction head as a positive suction



Bubble Point Determination Apparatus

head above absolute zero and to neglect the use of the terms suction head as being pressures above atmospheric and suction lift to being pressures less than atmospheric. It is necessary, of course, in making cavitation tests to measure suction lift or suction head as gage reading converted to suction head above absolute zero when the barometric pressure is known.

It was found that a correlation of the results could be obtained between the gasoline tests and water tests when reduced to certain basic values. To establish this correlation between the two, it becomes necessary to determine the minimum NPSH required to keep the pump in cavitation-free operation. To determine the minimum NPSH as applied to this test it is necessary to obtain the minimum values of the absolute suction head under cavitation-free operation which itself is calculated from the barometric pressure minus the suction lift. By subtracting the vapor pressure of fluid being pumped at a given temperature from the absolute suction head the minimum NPSH, or what we had designated as suction factor, is obtained. The suction factor similar to other characteristics of flow within the pump remains constant for a given speed and head and capacity condition for pumping fluids of the same low viscosity. Therefore the suction factor as obtained by pumping water in feet of water is the same for pumping gasoline in feet of gasoline for the same pumping conditions. By going directly to the tests and determining the suction head at which the pump would operate for the same conditions of service in both gasoline and water, it was found that the pump, when handling gasoline, required a great deal more suction head to operate cavitation-free than when pumping water. This was as expected. Therefore, we had four factors involved in comparing the two tests, the suction factor of the pump and the vapor pressure of the liquid for pumping both gasoline and water. As we knew the suction factor to be the same for gasoline and water and could obtain the vapor pressure of the water, we were able to calculate what we originally termed the apparent vapor pressure of 100 octane gasoline.

When plotting this curve of the apparent vapor pressure with the vapor pressure temperature curve for 100 octane gasoline as obtained from the refinery, we discovered a great deal of disagreement between these two curves. The values of the apparent vapor pressure curve were greater than the vapor pressure curve obtained from the refinery, being greater by amounts from 4½ pounds at 70° to 7 pounds at 100°. This was disturbing as it did not check our original premise or lend aid in trying to correlate the established vapor pressure characteristics of water and gasoline. We continued our tests by testing an enclosed runner pump and two Westco turbine type pumps, and from these tests obtained further confirmation of these apparent vapor pressure curves by the same method of analysis. These results, however, did give us the information needed to accurately predict suction limitations for handling 100 octane gasoline, assuming, of course, that there would be a similarity between all blends of 100 octane gasoline with the same Reid vapor pressure.

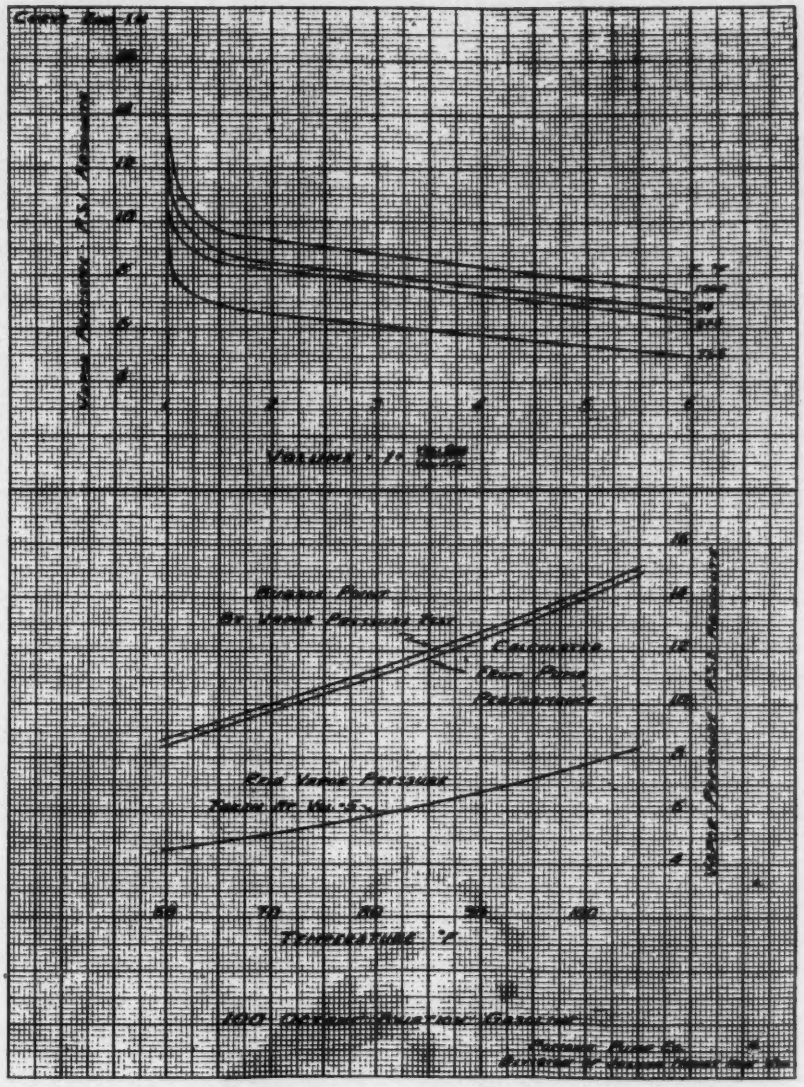
These results were still not satisfactory and we wished to carry the work further in order to establish the proper characteristics of the gasoline which would enable us to make accurate predictions as to gasoline suction limitations from our previously established water suction limitations. In checking with the refineries and discussing the problem with various people, it was found that the vapor pressure temperature curve that we had received from the refineries had been obtained from tests with a Field apparatus in which the vapor volume is approximately four times that of the liquid volume. Cavitation, as detected by small decreases in capacity from the normal head capacity curve, we now felt to be the manifestation of vapor pressure under conditions of limited vapor space. This gave a new interpretation of vapor pressure. Characteristics of the fluid under cavitation conditions presented a logical course to follow for further analysis. As a result of this interpretation, we first built a small vapor bomb in which we attempted to limit the volume of vapor space and measure vapor pressure temperature characteristics under these conditions. The results obtained from this apparatus were quite erratic but did indicate that as the vapor space was decreased, the vapor pressure at a given temperature was increased.

Because of this lack of ability to accurately measure the vapor pressure-temperature relationship under conditions of varying vapor volume, we contacted Dr. Sage. Through him we obtained information as to the proper type of apparatus with which to measure this apparent vapor pressure. Drs. Sage and Lacey have previously conducted many tests with an apparatus of this type to determine the bubble point of hydrocarbons and have written a book, "Volumetric Phase Behavior of Hydrocarbons", covering this work. The bubble point is that point on the pressure-specific volume diagram below the critical state where vaporization begins at a constant temperature. With this information at hand, we proceeded with the construction of a bubble point apparatus and conducted a series of tests in an attempt to correlate what we had previously called our apparent vapor pressure curve to a series of bubble points as obtained from the bubble point apparatus. The agreement between these two curves is quite remarkable; however, first let us describe the apparatus. (Slide No. 1) The apparatus, as used for the experiment, consisted simply of the gas measuring tube with an adjustable mercury reservoir. The gas measuring tube was jacketed by a glass cylinder through which water could be circulated and in which a thermometer was suspended. The sample of chilled gasoline was

siphoned into the gas measuring tube by lowering the mercury reservoir. By agitating the tube while raising the mercury reservoir, an air-free sample of gasoline of approximately 20 cc's was trapped in the tube. Water was then circulated through the jacket until a constant temperature was obtained. With the mercury reservoir raised high enough so that the sample remains in a liquid state, the mercury reservoir is slowly lowered, until a few bubbles of vapor have been formed above the liquid. The sample is agitating and a record is made of the vapor volume, total volume, temperature, and pressure. By lowering the mercury reservoir still further and taking readings for different values of vapor volume, a curve of the total volume-vapor pressure relationship at constant temperatures can be obtained. (Slide No. 2.)

On the curve, we have arbitrarily set the liquid volume as unit volume and plotted the total volume as equal to the liquid volume, plus the volume of vapor, divided by the volume of liquid. The bubble point is that point at which the vapor pressure curve for a given temperature intersects the coordinate representing unit volume. With patience, the bubble point can be found quite accurately with the apparatus used as the initial vapor volume in the apparatus is confined to that portion of the gasoline measuring tube just below the cock. The bore of the tube where the first small amounts of vapor are confined is approximately 3/32" in diameter while the bore of the tube in general is approximately ¼" in diameter.

By plotting a series of bubble points on a temperature-vapor pressure curve, we obtained the upper curve. From the cavitation studies of pumping both water and gasoline as previously outlined, a second curve shows the vapor-pressure temperature relationships as obtained by that method. The third curve shows an approximate curve that might be obtained by the Reid method, obtained by plotting the vapor pressure relationships for volume five of the

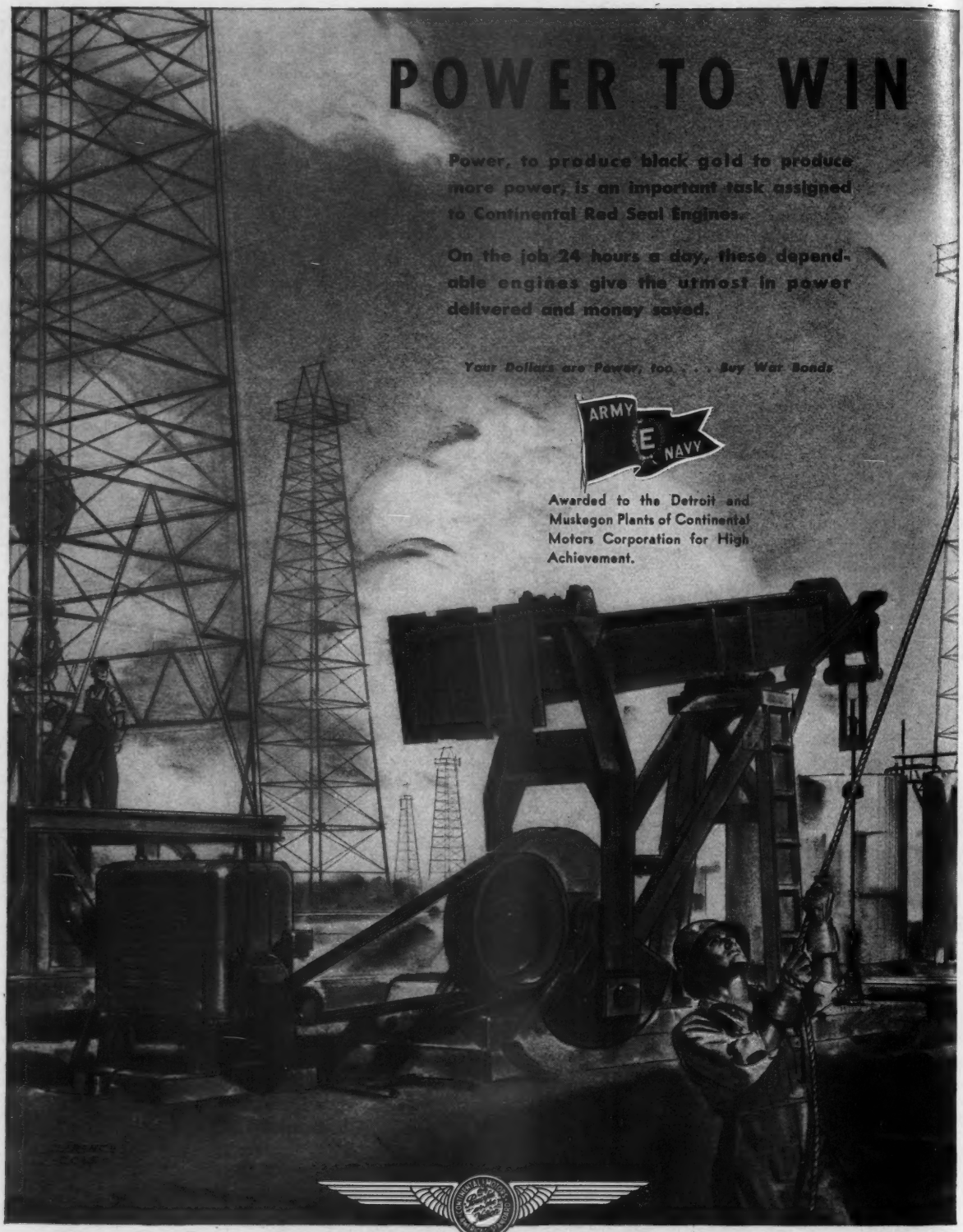


previous vapor pressure - volume curves.

As can be seen from these curves, there is very close agreement between the bubble point and the apparent vapor pressure for a given temperature; whereas the Reid vapor pressure and the apparent vapor pressure were in wide disagreement. Within the accuracy of the test equipment, we could for all intents and purposes say that the bubble point and apparent vapor pressure describe the same limiting vapor pressure necessary to evaluate the cavitation limitations in pumping gasoline.

However, we cannot assume this to be entirely true as there are minor modifying limitations between the measurement of the bubble point by the apparatus and the detection of bubble point in pump cavitation. There is primarily the time element; that is, the apparent vapor pressure values could be slightly modified from the bubble point by the extremely small lapse of time during which the gasoline is exposed to the low pressure of the maximum suction velocity. This is true as it takes a certain amount of time for the vapor pressure-liquid volume relationship to reach equilibrium. This would result in the apparent vapor pressure having a value equal to the vapor pressure at a volume slightly larger than one for a given temperature. Attributing the differ-

(Continued on Page 35)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"The Reciprocating Steam Pump in the Natural Gasoline Plant"

By H. P. Henderson
Engineer, Worthington Pump and Machinery Corp.

April Meeting

In considering the reciprocating steam pump and its particular application to the problems of transferring water, oil and the lighter liquid hydrocarbons through the natural gasoline plant, it will be well to review the various types and forms of this reliable piece of equipment.

Duplex pumps are those having two liquid cylinders side-by-side while the singles or "simplexes" are those in which only one cylinder is employed in each unit.

The steam valves are controlled by the motion of the piston rods which perform the function of transmitting the power from the steam cylinder to the liquid cylinder. These steam valves are of two general types: namely, the "D" slide valve (figure 1-a) and the piston valve (figure 1-b). The slide valve is suitable for most steam conditions encountered in natural gasoline plants and elsewhere provided the total steam temperature is 450° F. or lower. Where total temperatures range between 450° and 550° F. the piston steam valve is recommended because of its better lubrication, longer life and freedom from warpage under superheat.

There are many types of liquid ends but there are only three of these that are suitable for use in the natural gasoline plant. One of these is the time-honored cap-and-valve-plate design, figure 2a, and another the turret pattern, figure 2b, which have been used since the early days of gasoline plants for all services. However, there is now a better design for the lighter products,—the side pot pattern shown in figure 3. The cap-and-valve-plate and turret patterns are now used chiefly for cooling water, absorption oil and low vapor pressure products.

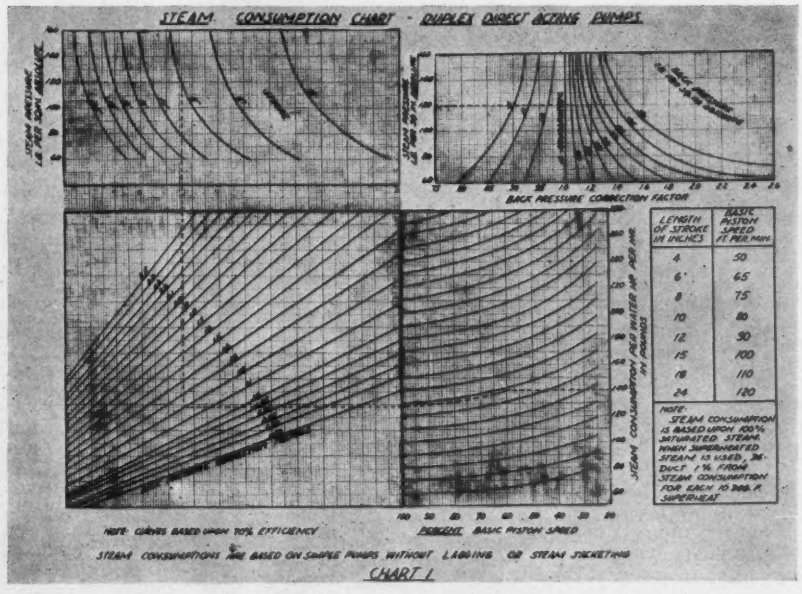
Close clearance pumps are well designed side pot pumps in which the clearance spaces have been reduced to the lowest possible value. Figure 4 shows one close clearance side pot design called the Hivol. Compare this with figure 3 and you will see that the spaces which in the conventional side pot pump are open to the liquid are in the design of figure 4 eliminated to as great an extent as possible. Convention has been discarded and compressor practice followed.

This unconventional pump has a clearance volume of only 16 to 20 per cent while the cap-and-valve-plate design has a clearance volume of between 125 and 200 per cent. The close clearance type pumps were tested as dry vacuum pumps and air compressors with remarkable results. Cylinders were oil lubricated to furnish a seal in the same manner that the liquid being pumped normally seals the piston. As vacuum pumps the pressure oblowest vacuum and to 1.25 inches tained was reduced to from 3.7 inches of mercury absolute for the mercury absolute for the highest vacuum! Similarly, as air compressors, pressures could be maintained between 135 and 225 P. S. I. gauge.

The significance of these tests will be discussed later in this paper.

Valves in the liquid end of a steam pump are as varied in design as milady's hats. To discuss the relative merits of the various makes or forms of valves has no place here and we therefore will confine our remarks to the basic requirements and functions of liquid valves. The two basic types are the disc and the guided types. Both have some points in common and these will be examined first. Neither disc or guided type valve should be allowed to lift higher than ⅛" per inch of diameter or slamming and clatter will result which is not only annoying but will lead to untimely wear and destruction. This is an old rule-of-thumb based upon long experience and is entirely satisfactory.

Let us now examine the losses or pressure drop through a valve


STEAM CONSUMPTION CHART - DUPLEX DIRECT ACTING PUMPS
BACK PRESSURE CORRECTION FACTOR
LENGTH OF STROKE IN INCHES
BASIC PISTON SPEED FT. PER MIN.
4 50
6 65
8 75
10 85
12 90
15 100
18 110
24 120
NOTE: STEAM CONSUMPTION IS BASED UPON 100% SATURATED STEAM. WHEN SUPERHEATED STEAM IS USED, 3% DUCT 1% FROM STEAM CONSUMPTION FOR EACH 10 DEG. F. SUPERHEAT
NOTE: CURVES BASED UPON 70% EFFICIENCY
PERCENT BASIC PISTON SPEED
STEAM CONSUMPTIONS ARE BASED ON SIMPLE PUMPS WITHOUT LAGGING OR STEAM JACKETING
CHART 1

and the pressure required to get it open.

In Figure 5 let:

A equal the nominal diameter of valve.

A equal the area of diameter A.

B equal the inside diameter of the valve.

B equal the inside area of the valve.

S equal the spring force in pounds.

W equal the weight of the valve.

Pa equal the pressure on A. P.S.I.

Pb equal the pressure on B P.S.I.

With the valve closed, the force necessary to open the valve is—

(1) $P_B \times B = P_A \times A + S + W$

(2) $P_B = \frac{P_A \times A + S + W}{B}$

(3) $P_B - P_B$ equals opening differential or pressure required to get the valve open.

On a conventional valve such as used in a Worthington 6x4x6 duplex steam pump, we find the following:—

A equals 3.31 and **A** equals 8.19 sq in. (XX)
B equals 2.15/16 and **B** equals 6.06 sq. in. (XX)
Sc equals 3.25# (valve closed)
So equals 5.87# (valve open)
W equals 0.5#
and $P_B - P_A$ becomes (.35 P_A + .62) P.S.I.
(XX—allowing for the guard hole).

Thus we see that the pressure differential to open the valve is affected very slightly by the spring pressure and the weight of the valve, and to a marked degree by the width of the seat.

If this was a suction valve with boiler feed coming to it at 210° F. and with a net positive head measured at the valve seat of 15 feet, would the valve open without the water in the clearance spaces of the pump flashing? Let's see.

Vapor pressure of 210° water is 14.13 P.S.I. absolute.

15 feet of water at 210°F. is equivalent to 6.2 P.S.I.

Total absolute pressure at underside of valve is therefore 20.33 P. S. I. absolute. The pressure drop is 5.63# and pressure inside the cylinder is 14.7# absolute. This is greater than the vapor pressure of the liquid and there should be no vaporization.

As soon as the valve is open area **A** equals area **B**. The correct lift of the valve in question would be 1/8" x 3.31" or 13/32" maximum. The clear area through the seat of this valve is 5.03 sq. in., and with 13/32" lift, the peripheral area is 4.22 sq. in.

When flow starts through the valve, the valve flow loss must be added to formula (2). This expression is derived as follows:—

$$h \text{ (feet) equals } \frac{V^2}{2g}$$

Where V is the velocity through the system in feet per second. Assuming a discharge coefficient of .8 and converting to pounds per sq. in., we have—

$$\frac{V^2 \times \text{Sp. Gr.}}{2 \times 32.2 \times .8 \times 2.31} \text{ or } \frac{V^2 \times \text{Sp. Gr.}}{119}$$

Our formula then becomes—

(4) $P_B = P_A + \frac{So + W}{A} + \frac{V^2 \times \text{Sp. Gr.}}{119}$

For simple calculation, you may use the following formula to calculate the velocity through the valves:—

(5) $V = \frac{.64 \times \text{GPM}}{\text{Net area} \times \text{no valves per function per section}}$

Thus, if the pump in question was handling 35 GPM, the valve loss is—

$$\frac{(5.31)^2 \times .96}{119} \text{ equals } 0.18 \text{ P.S.I.}$$

This is for all practical purposes a negligible quantity.

The area of the suction valves relative to the piston area is a rather widely varying figure and depends upon the type of liquid end, its size and long established practise and experience of the pump design engineers. In general the the cap-and valve plate and turret pattern pumps will have valve area ratios ranging from 25 to 30% of the piston area. Pot valve and special close clearance design pumps will have valve area ratios ranging from 35 to approximately 50% on the very largest pumps. The highest percentages are recommended for viscous liquids encountered in refinery work but are often used in natural gasoline plants for high capacity work.

Reasonable speeds must be maintained on steam pumps if good, reliable service is to be obtained under all conditions.

What constitutes "reasonable speed" is a point of considerable controversy. Some pumps are treated as if their operators felt that any speed was all right provided the steam valve motion did not come apart or the pistons knock the heads out of the pump. Such operation is distinctly bad because it leads to short life of not only pumps but usually to exchangers, piping, controls, etcetera, as well. Hydraulic shock or water hammer is usually set up and this may be destructive to equipment beyond the pump.

Reasonable speed is usually best determined by liquid valve and cylinder performance. Valve and cylinder performance are dependent upon the characteristics of the material being handled, the intake pressure and equilibrium conditions, and the intake piping. A pump may operate beautifully at a speed of 20 RPM handling propane with a valve velocity of 100 feet per minute and with the liquid cylinder filling completely each stroke. If the pump is speeded up to 30 RPM, the result may be lack of filling of the cylinder due to excessive valve loss and consequent vaporization or due to added intake line velocity causing additional line losses which will cause flashing upon opening the suction valves or other similar causes. Yet with changed intake conditions the same pump may handle the increased quantity of the same liquid with ease as before.

The designers and operators of pumping systems must keep constantly in mind that there is no

such thing as "suction". The pump, whether it be positive displacement or centrifugal, can force the liquid out but some external force such as atmospheric or tank pressure and gravity must cause the liquid to force open any line check valves, control valves or pump valves and flow into the pump.

Generally speaking, pumps handling water and oils with viscosities under 250 SSU can be operated at speeds as follows:—

6 inch stroke	45 feet/minute.
10 inch stroke	63 feet/minute.
12 inch stroke	70 feet/minute.
18 & 24 inch stroke	90 feet/minute.

For volatile products these may have to be reduced 10 to 50 per cent depending on intake conditions and valve velocities.

Liquid valve velocities in the order of 90 to 150 feet per minute will usually be found satisfactory for volatile liquids whereas these velocities may be run up to as high as 250 feet per minute or even more for handling very light oils and cold water.

Capacities and sizes of pumps may be quickly determined if one will remember a few simple facts and keep in mind the piston speeds given earlier in this paper. For simplicity remember that the following cylinders, one foot long, have the following capacities:—

3½"	½ gallon
6"	1½ gallons
7"	2 gallons
11"	5 gallons

Select a suitable size and divide into the capacity to be handled. If it falls within the range of speeds for a reasonable liquid cylinder size, then select a suitable steam cylinder size from the ratio of the steam pressure and liquid pressure with about 70% pump efficiency.

Example:

Desired—pump for 45 GPM cold absorption oil.

Pump pressure 180 PSI gauge, steam pressure 125 PSI gauge, atmospheric exhaust.

Try—3½" pump, 6" stroke.

STEAM PUMP ILLUSTRATIONS

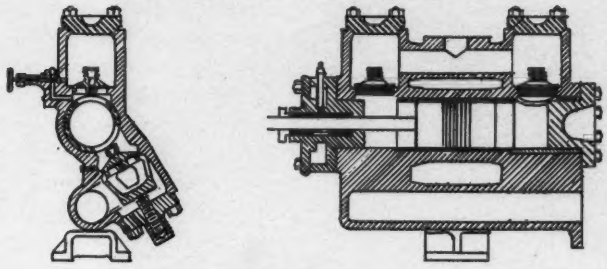


Figure 4

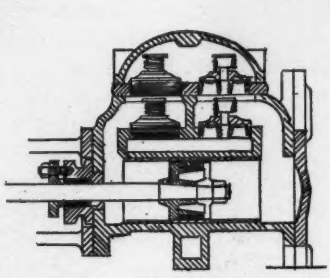


Figure 2-A

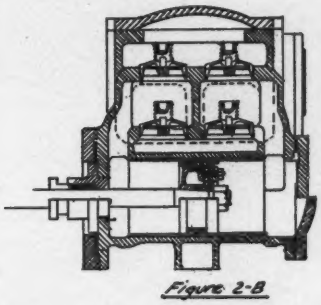


Figure 2-B

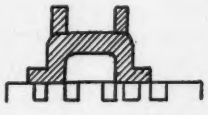


Figure 1-A

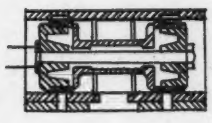


Figure 1-B

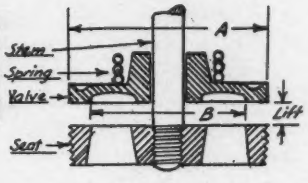


Figure 5

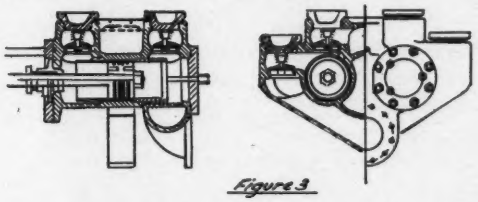


Figure 3

1/2 x 45 equals 22½ GPM. If the pump is a duplex, the selection is good for 45 GPM. The nearest standard size is a 6 x 4 x 6.

Pump is large enough as selected.

Pump mechanical efficiencies will vary with size of pump, type packing, amount of load or pressure, tightness of rod packing and general condition of wear. Units in good condition with new, well broken-in packing, on rated pressure will range from 50% for a 3 inch stroke pump through 65% for a 6 inch stroke, 78% for a 12 inch to 85% for 24 inch stroke. For practical purposes a figure of 70% is usually used for calculations.

$\left(\frac{6}{4}\right)^2$ x .7 x 125 equals operating liquid pressure or in this case—197 P.S.I.

The steam consumption of a steam pump may be approximated quite readily as follows:

Calculate the displacement of the steam end in cubic feet per hour. Also calculate (or measure) the actual steam pressure in the valve chest, taking into account pump mechanical efficiency and cylinder ratio. Multiply the calculated displacement by the density of the steam at the pressure and estimated

quality. Increase this result by 15% to allow for the steam in the clearance spaces of the cylinder. If the pump is a simplex, increase this result by 75% to allow for condensation, stuffing box loss, etcetera. However, if it is a duplex pump increase by 90 to 100% depending upon smoothness of operation. The rougher running, short stroking pump uses more steam. The chart gives these steam consumptions very readily and is self-explanatory except that the results may be reduced by 10% for simplex pumps.

The close clearance simplex pump is finding very wide application in the natural gasoline industry because these pumps can make up for bad suction conditions and still deliver the required amount of liquid. It is often necessary to install a pump in an existing plant to take its feed from a tank located without sufficient head. This usually results in gassing to the extent that a pump having vacuum pump and gas compressor characteristics must be used if any liquid is to be delivered. Since the close clearance pumps, as outlined earlier in this paper, do have compressor characteristics and since other pumps with greater clearances would gas bind, then in these cases the close clearance pump must be used.

Plant engineers and designers should not, but sometimes do, take advantage of the characteristics of close clearance pumps and locate supply tanks so low that even close clearance pumps have no chance to give the service for which they were designed with the more serious results of bottle-necks in the plant.

Notwithstanding the widespread use of direct acting pumps of both single and duplex types there still seems to be some confusion with regard to the comparative merits of the two kinds of construction. Each type has its advantages and its staunch supporters and a broad survey of the field would properly disclose the fact that in the matter of preference of one over the other opinion is about evenly divided.

The duplex pump is an extremely simple machine and its operation is easily understood by the most inexperienced engineer. It will stand an astonishing amount of abuse and will always run— in some sort of way—even when in the most wretched condition, although the amount of water pumped may be very much below rating and the steam wasted in driving it, an appalling amount—but it will run. Then, too in case of total collapse it is usually comparatively easy for any attendant to tinker up the troubles temporarily at least, and then start pumping again.

The water flow, from a duplex pump is smooth and free from fluctuation. Furthermore, the first-cost is usually a little less than that of a simplex pump of like capacity. On the other hand there are practically two pumps with all their operating parts which are needed to do the work of one.

An undesirable feature of the duplex pump is its tendency to short stroke, on account of unequal friction in the working parts of the two sides, due to the difficulty of packing the stuffing boxes and pistons of both sides equally tight. This not only decreases the water discharge but increases in an equal degree the steam clearances, which means steam waste.

The simplex pump is a machine somewhat more refined in construction than the duplex pump yet consisting of but few parts and when all is told is a very simple affair requiring but ordinary attention—as little as an engineer would give to the humblest piece of his equipment. In comparison with its duplex relative, it has certain features in its favor, some of which are as follows.

It occupies less space—has fewer wearing parts—but half the number of stuffing boxes, pistons and joints to pack and keep in order—makes full stroke at all times—will not short stroke under any running conditions, which means less clearance space that must be filled with steam and a saving that may be from 10% to 30% in steam consumption—has less steam cylinder condensation—is much better adapted for handling hot water, gases, mixtures of liquids, gases and propane or any service where liquid cylinder may not entirely fill with liquid at each stroke.

Conservative figures of a comparison of the steam consumption of the two types of pumps show that duplex pumps in the best of running conditions use from 10% to 30% more steam than simplex pumps of equivalent capacity and from 25% to 50% more when the duplex pumps are in only ordinarily fair working shape. This statement may possibly surprise many who have based their opinions on the too commonly accepted fact that all direct acting pumps are equally wasteful steam users.

In line with the above facts general conditions should determine the type of pump most suitable for a given service. If the pump is likely to be roughly handled, exposed to bad weather and subject to neglect—or if in the pump installation the steam after being used in the pump can all be profitably utilized for plant process purposes, etc., then the duplex pump will well fit the case.

If on the other hand, conditions are such that maximum economy in operation is sought, together with high efficiency generally, then the simplex pump is the logical unit. It is nevertheless true that many pump installations are based not on facts as above presented, but on the engineers' preference for either one or the other type, due to long familiarity with duplex and simplex pumps as the case may be.

In conclusion it should be noted that the steam pump is not an out of date machine but rather one that has a great many uses for which there is no substitute. For those who will spend the time to study the conditions of service, particularly with respect to intake conditions and apply and operate steam pumps carefully, there are rich rewards in plant economies.

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American Tiger Brand Wire Rope has long life and service built into it. No other rope will last longer under tough usage. Or is easier and safer to use. But even a quality rope like U·S·S American Tiger Brand requires care and attention to give the maximum service and top efficiency required right now.

Send for this Free Booklet

Every user of wire rope can get a lot of good ideas from this informative book. It's packed with easy-to-follow instructions. Pocket-size, handy and thoroughly practical, "Valuable Facts" will help you avoid common errors of handling and care that shorten rope life. Order as many copies as you need. Get them into the hands of the right men. Never forget—wire rope is indispensable to the war effort—you've got to make it last.

COLUMBIA STEEL COMPANY
San Francisco

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

United States Steel Export Company, New York

USS

Excellay Preformed

UNITED STATES STEEL

THIS LAUGH

OFF!!

"Seems there was an Irishman, walking down a London street after an air raid, who had a doorknob in his hand. A friend stopped him and asked what ailed him? 'Those darned Germans! They just blew a saloon out of my hand!'"

The story is told of the tribesman who bought a bottle of cough syrup at the Cut Bank drug store. The following day he returned for another bottle, and on the third day he bought three more.

"Everyone having colds?" asked the druggist.

"Nope," was the reply. "Me like 'em on hot cakes."

A small girl asked her mother: "If I grow up will I have a husband like papa?"

"Yes, my dear," mother replied.

"And if I do not get married will I be an old maid like Aunt Susan?"

"Yes," was the reply.

The little girl thought for a minute, put her hands to her head and said: "Well, I am in a fix!"

The hen is immortal; her son will never set.

And then there was the girl who was so lazy she wouldn't even exercise discretion.

He: "I've lost my little woman."
She: "How did you lose her?"
He: "She got fat."

Doctor: "Nurse, you've been with that handsome patient in 402 over an hour."

Nurse: "Don't stop me now. I've got to get a thermometer."

Doctor: "Gosh, is he running a temperature?"

Nurse: "No, but I am."

"I'm glad your last customer looked so pleased," said the manager to the sales girl. "What did he want to see?

"Me, at seven thirty."

I'd better warn you—my husband will be home in less than an hour."

"But I've done nothing I shouldn't do."

"Well, I just wanted to warn you that if you're going to, you'd better hurry."

"Old Doc Curem has given his young wife two days to live."

"Is that so?"

"Yeah, he went out of town for a couple of days."

Husband: "Did you finally pay the iceman, dear?"

Wife: "Yes, yesterday."

Husband: "How much did you give him?"

Wife: "Oh, er — er — about two dollars and something."

The stingiest man we ever heard of bought his bride a nickel's worth of peppermint lozenges and took her on a trolley-ride honeymoon. When they got off the car he said, 'Honey, suppose we save the rest of this candy for the children."

"How do you spend your income?"

"About 30% for shelter, 30% for clothing, 40% for food and 20% for taxes."

"But that adds up to 120%."

"Don't I know it?"

The engineer asked her if she was doing anything that evening and she said she wasn't and so he took her out and sure enough, she wasn't.

"Say, what's this I hear about you being asleep at the switch last night?"

"It's right, darn it; I was asleep when the blonde across the street switched from her negligee to her pajamas!"

You Can . . . with a JENSEN

You can balance out the load with a JENSEN, so that the down stroke really does require the same power as the up stroke.

You can do many things with a JENSEN that you can't do with an ordinary pumping unit, and a lot of California producers have found that out. For economy's sake, and wartime efficiency, ask about JENSEN UNITS.

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BROTHERS MFG. CO.
Coffeyville, Kansas, U.S.A.

EXPORT OFFICE: 50 Church St., New York City

Presenting The Men and Women of Clark Brothers Co., Inc. with the Army-Navy "E" Award.

CLARK BROS. AWARDED "E"

For their "fine record in the production of war equipment," the Army-Navy "E" Award was conferred, March 27, upon the men and women of Clark Bros. Co., Olean, N. Y.

The presentation ceremonies, held in the Olean Armory before an audience of 3500, were given unusual interest and impressiveness by the genius of John B. Kennedy, renowned radio and screen commentator, who presided.

Representing the Army, Lt. Col. Ernest W. Ogram paid tribute to the company for its quick and complete mobilization for the production of war equipment, and commended the employees for the "excellent job done to date." Speaking for the Navy, Com. R. G. Walling charged all civilians with the duty of "seeing that our armed forces are supplied with the best equipment that can be made. That you at Clark Bros. Co. have not failed in your duty," he continued, "is shown by our being here today."

The "E" pennant was accepted on behalf of both management and employees by C. Paul Clark, president of the company. "E" Award pins were thereupon presented to representatives of the entire organization. The ceremonies concluded with an address by Mr. Rich, president of the Employees Association, who accepted the pins in behalf of the employees with a promise that the men and women of Clark Bros. would continue in action "until the day Hitler's unconditional surrender comes."

The award of the "Army-Navy "E" pennant marks another milestone in the history of a company that began in 1880 as a manufacturer of sawmill and agricultural machinery, switched to gas engines early in the current century, and has been progressing with giant strides ever since. Today the organization has tripled in size over peace times and its products are shipped to every part of the world in which the United Nations operate. The wartime significance of those products can best be measured by a study of a few of their uses—as the motive power of Liberty cargo ships; in the manufacture of high-octane aviation fuel and Butadiene, ingredient of synthetic rubber; in the production of explosives, and in the operation of a new process for the recovery of magnesium.

National Supply Reports For First Quarter

Sales of the National Supply Company for the first quarter of the year were approximately $35,000,000.00, an increase of about 67% over sales for the same period in 1942, A. E. Walker, President, reported to the annual meeting of stock holders in Pittsburgh on Tuesday, April 7.

Walker revealed that increased volume has reduced the cost of war materials for the Army and Navy to such an extent that the company has made numerous voluntary reductions in price and will continue to pass on to the government the benefit of reduced cost after a normal margin of profit.

National Supply is principally known as the manufacturer of National Ideal Oil Field Machinery and Equipment, Superior Diesel Engines, and many types of Spang Pipe, all of which are vital to the nation's war effort. Now, in addition, the company is making such direct war products as shell forgings and bombs, gun forgings and mounts, propulsion gear and propellor shafts for naval vessels, and landing gears for bombing planes.

For its excellent record in war production, National Supply has already received the Victory Fleet Flag, the Maritime "M" and the Army-Navy "E".

Warman Steel Announces Appointments

Wm. P. McGervey, Jr., Vice President of the Warman Steel Casting Company, announced on April 8th the following appointments:

M. W. Cardwell, Comptroller; W. C. Burger, Sales Manager; E. B. Westall, Plant Metallurgist; W. B. McCartney, Jr., Production Engineer.

Oil Workers are War Workers.

H. E. Cassidy

McCarty Co. Vice President Elected

Announcement has just been made of the election on April 6 of Hiram E. Cassidy, Vice President of the McCarty Co., to the Chairmanship of the Southern California Chapter of the American Association of Advertising Agencies. This honor follows his recent election to the Board of Governors.

The McCarty Co. is one of eighteen advertising agencies in Los Angeles and Hollywood who are members of the 4-A group. Membership in the Association requires strict adherence to a stringent code of ethics in advertising procedure.

"Hi" Cassidy has been with The McCarty Co. for fifteen years. During this period he has directed the national advertising of many major companies and has contributed much to the field of advertising. This recognition by men in his field is richly deserved.

C.N.G.A. meets regularly the first Thursday of each month at Rio Hondo Golf Club, 607 North Old River School Road, Downey. Dinner at 6 P.M., meeting at 7:30 P.M. Meetings open to all those interested.

April Meeting Junior Members A.I.M.E.

Some thirty Junior members of the Southern California section of the A. I. M. E. convened on April 1st in Huntington Park for their regular monthly dinner meeting. Subject for the evening was the important economic topic of "Curtailment in California—Past, Present, and Future", presented by two of the instigators and long time exponents of California's curtailment system: Joseph Jensen, Chief Petroleum Engineer, Tide Water Associated Oil Company; and L. E. Porter, Assistant Manager of Exploitation, Richfield Oil Corporation.

Mr. Jensen opened his address by quoting three main conclusions he had reached some years ago in a paper summarizing developments in curtailment: 1). Regardless how adaptable and equitable a curtailment system may be at the time of its inception, conditions within a relatively short time will so change that the system will no longer be practicable. 2). No adequate system can be put into effect without the cooperation and participation of all parties concerned. 3). In any curtailment system the greatest concessions must be made by the large operators—particularly the operators of high-potential wells. The speaker then briefly discussed the initial attempts to to establish a curtailment system in the state and went on to review the development of curtailment with respect to the high points of California's production history. The accuracy of his three generalizations appeared fully confirmed in the light of past and present events.

The second phase of the evening's program consisted of comments by Mr. Porter on the present and future status of curtailment. The essence of these remarks may be summarized as follows: 1). Due to declining reserves, cooperation on the part of both landowners and operators will be easier to secure than in the past. Thus the installation and maintenance of an equitable, efficent production program will be largely contingent upon sound engineering practice. This presents new opportunities—and a real challenge—to the engineer. 2).Rather than to limit excess production, the future role of "curtailment" will be to recover a maximum amount of oil from existing reservoirs. Such a goal, if it is attained, may prove as important as the discovery of new producing horizons.

Both Messrs. Jensen's and Porter's talk were highlighted throughout by numerous anecdotes and points of interest. A lively discussion ensuing from the talks demonstrated the interest and appreciation of the group. In concluding the evening's program, it was announced that M. B. Standing, Petroleum Engineers, Standard Oil Company of California, would discuss "Retrograde Condensation" at the May 13th meeting of the chapter.

How would you like to eat 1/25th of your weight at a single meal? If you were a midget this would be no trouble at all because you would have a huge appetite—two or three times that of normal people. It would be no job at all to drink liquids equal to the amount required for your bath. One midget just 45 inches tall downed a seven-course dinner, including a steak, following up with two quarts of milk, with no trouble whatsoever.

The United States has the seventh lowest infant death rate in the world, which totalled 47 per 1,000 live births in 1940. Pre-war death rates were smaller in Sweden, Norway, the Netherlands, New Zealand, Australia and Switzerland.

The Army Air Force may do their fighting in the air, but they use a lot of equipment on the ground, including 75 kinds of motor vehicles which comprise 50 standard army trucks, jeeps, etc., and 25 special vehicles from plane "tugs" to crash trucks.

Field Development

Los Angeles Basin

Tar Zone Well Good Producer

Long Beach Oil Development Co.'s recently completed "X" No. 14, first Tar Zone completion in the Harbor section of the Wilmington field, is sustaining its surprising inital flowing rates. Last production was 88 B/D-15.1 gravity-0.1%-10/64 in. bean-500/700 lbs. pressure and 146,000 cu. ft. of gas.

The company finished "W" No. 49 at 2992 ft. flowing 335 bbls. per day of clean 19.8 gravity oil through a 20/64 in. orifice under 280 lbs. tubing pressure and is completing "W" No. 53 on the pump at 2531 ft. after flowing 12.9 gravity oil from the tar zone at an estimated 60 bbl. rate. Immediate projects are "W" Nos. 43, 44, 45, 47 & 50, for which Hiles Drilling Corp. has the contract and Z-1-1-Z & Z-1-2-Z to be drilled by J. M. Jackson, Inc.

Other activity in the field is Royalty Service Corp.'s Gilmore No. 842-2, which is plugging off the Ford zone to redrill and complete in the upper horizons, Oil Investments, Inc. Advance Truck No. 4 now cleaning out to redrill and Zephyr Oil Co.'s Lupie No. 1 which is completing after redrilling to 3565 ft.

Union Pacific Railroad Co. is continuing its remedial program in the field with one string steadily at work. The company is redrilling No. 18 after redrilling and putting No. 44 on the pump at 3246 ft. for 80 bbls. of clean 20.2 gravity oil.

Richfield Oil Corp. is preparing to drill Pacific Dock No. 33 at the north shore of Channel No. 2 while Brookline Oil Co. is completing plans intended to drill a series of Ranger zone wells near the extended intersections of A and Banning streets, north of the East Basin.

Several redrill jobs are scheduled for varying portions of the field with the starting dates yet undetermined owing to the unavailability of contractors with light spark plug drilling rigs.

Urban Wildcat Nears 8000 Ft.

Shell Oil Co., Inc.'s Verne Community No. 1, specially rigged and fitted out for noise, fume and general nuisance abatement in a concentrated residential area near First and Gardner Streets in the City of Los Angeles, was last reported drilling ahead at 7904 ft. after running electric log and dip meter at 7666 ft. Drilled in an effort to establish production under the old shallow Salt Lake field zones, the well has not to date reported encountering the expected Sentous zone equivalent, proved prolific in the not far removed Inglewood field, nor has encouragement been given out concerning the possibilities of the old producing shallow zones. The large area under consideration however affords considerable future prospecting if the current site should prove unfruitful.

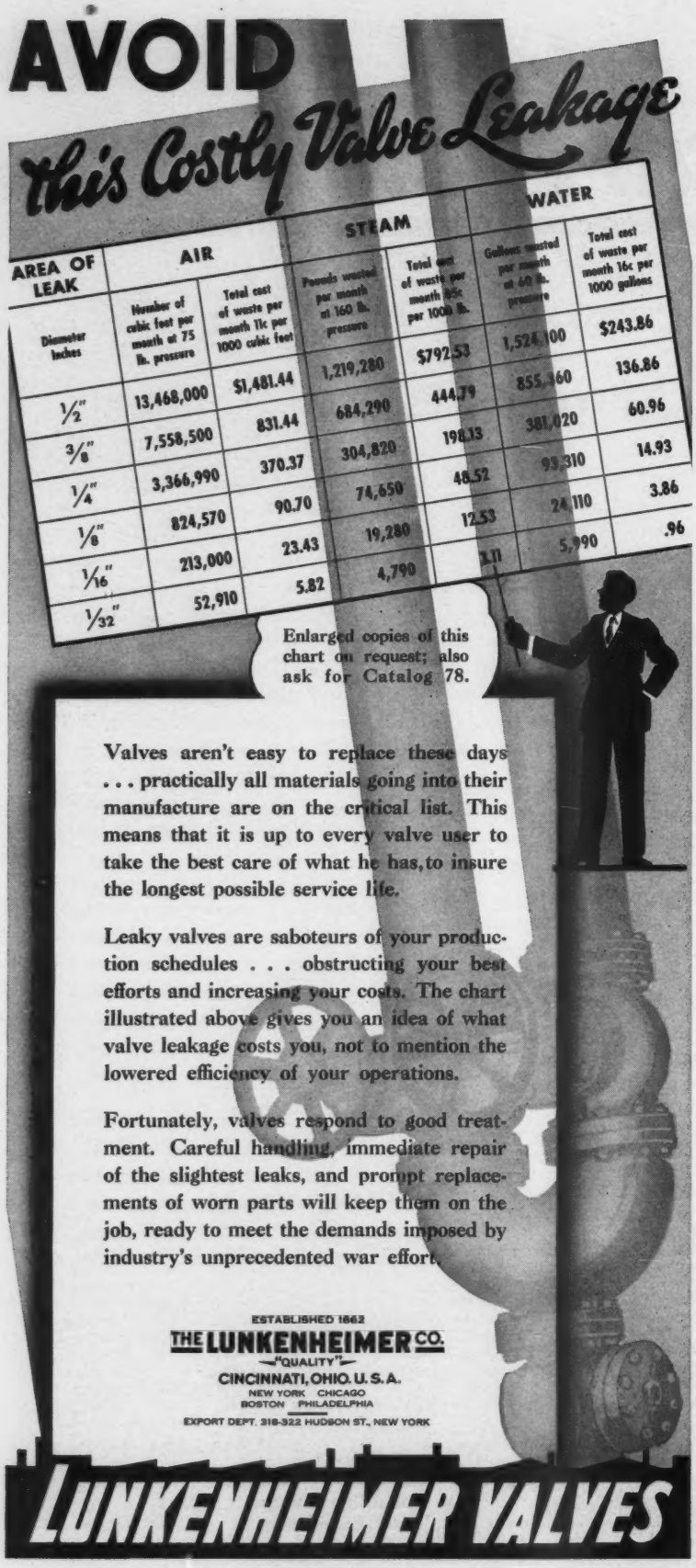
This is the first metropolitan area to be tested for war-time oil production but plans are under way for additional tests all along a huge geologic uplift which affords interesting prospects for valuable reserves.

Torrance Work Up

Activity in the Torrance field is presently on the up beat. In the Redondo section of the field two wells are redrilling with several addition grass root jobs scheduled to fol-

LOS ANGELES BASIN WILDCATS

Area	Well	No.	Section	Depth	Status
La Mirada	The Texas Co., McNally	A-3	22, 3-11	9110	Drilling
Las Llajas	Western Gulf Oil Co., Brady	1	13, 3-17	9106	Drilling
L. A. City	Shell Oil Co., Inc., Verne Comm.	1	24, 1-13	7666	Drilling
Montebello	Cont. Oil Co., Baldwin	1	3, 2-11		Grading
Newhall	Aztec Oil Co., Sanborn	1	6, 3-16	7327	Idle
Puente	Barry Oil Co., Inc., Rowland	1	14, 2-10	2423	Pumping
	Melvin Hansen, Dragna	1	24, 2-10	3009	Drilling
Rio Hondo	Potrero Oil Co., Newman	1	32, 1-11	7111	Abandoned
Temescal	The Texas Co., Dominguez	57-1	1, 4-18		Location
Whittier-La Habra	H. & C. Oil Co., Joyce	1	22, 2-11	5299	Drilling
	Los Nietos Valley O. Co., Woodward	1	29, 2-11	3600	Redrilling
	Orange County				
Costa Mesa	Chas. W. Camp	25	15, 6-10	1534	Abandoned
	Carrey, A. A., Meyer	1	16, 6-10	640	Drilling
Newport Beach	D. W. Elliott Townsend	1	20, 6-10	2350	Drilling
	San Bernardino County				
Carbon Canyon	Veta Grande Dev. Co., McDermott	2	5, 3-8	1184	Idle
Colton	Supreme Oil Co., Well	1	2, 2-4	940	Idle


AVOID
this Costly Valve Leakage
AREA OF LEAK
AIR
STEAM
WATER
Diameter Inches
Number of cubic feet per month at 75 lb. pressure
Total cost of waste per month 11c per 1000 cubic feet
Pounds wasted per month at 160 lb. pressure
Total cost of waste per month 85c per 1000 lb.
Gallons wasted per month at 60 lb. pressure
Total cost of waste per month 16c per 1000 gallons
1/2" 13,468,000 $1,481.44 1,219,280 $792.53 1,524,100 $243.86
3/8" 7,558,500 831.44 684,290 444.79 855,360 136.86
1/4" 3,366,990 370.37 304,820 198.13 381,020 60.96
1/8" 824,570 90.70 74,650 48.52 93,310 14.93
1/16" 213,000 23.43 19,280 12.53 24,110 3.86
1/32" 52,910 5.82 4,790 3.11 5,990 .96
Enlarged copies of this chart on request; also ask for Catalog 78.
Valves aren't easy to replace these days . . . practically all materials going into their manufacture are on the critical list. This means that it is up to every valve user to take the best care of what he has, to insure the longest possible service life.
Leaky valves are saboteurs of your production schedules . . . obstructing your best efforts and increasing your costs. The chart illustrated above gives you an idea of what valve leakage costs you, not to mention the lowered efficiency of your operations.
Fortunately, valves respond to good treatment. Careful handling, immediate repair of the slightest leaks, and prompt replacements of worn parts will keep them on the job, ready to meet the demands imposed by industry's unprecedented war effort.
ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK
LUNKENHEIMER VALVES

low. LeBow-McNee is completing Dominguez No. 1 after redrilling to 3655 ft. and Thos. W. Simmons is rigging up to redrill Regent No. 1 from the 1000 ft. level. Mr. Simmons just finished redrilling Redondo-Simmons No. 11 to 3450 ft. which was last reported pumping 35 bbls. of clean 14 gravity oil. Also recently completed was Wood-Callahan's new Dominguez Estates No. 4 which is making 50 bbls. of 15 gravity oil from 3664 ft.

In the Wilmington-Torrance sector of the field The Texas Co. is preparing to spud Oakley No. 8 for Terminal zone production.

Las Llajas Try Now Drilling Deep

Western Gulf Oil Co.'s Brady Estates No. 1, on sec. 13-3n-17w, which is prospecting a structure some two miles south of the Pico Canyon field, was last reported drilling in hard shale at 9106 ft. The current formation has to date shown no evidence of production capacity, nor have uphole showings been reported. The well is located where upper Miocene formations are on top.

Southwest Expl. To Drill Jones Sands

Southwest Exploration Co. poured foundation for the first four of 22 Jones sand wells alongside its present Tideland area production in the Huntington Beach field. First to get under way will be State No. J-9 which will be spudded about May 1st at a point 123 ft. north and 1871 ft. west of the centerlines of 23rd and Ocean Avenues. The company is at present drilling its No. 54 at 4960 ft. on its way to a final depth of 5200 ft.

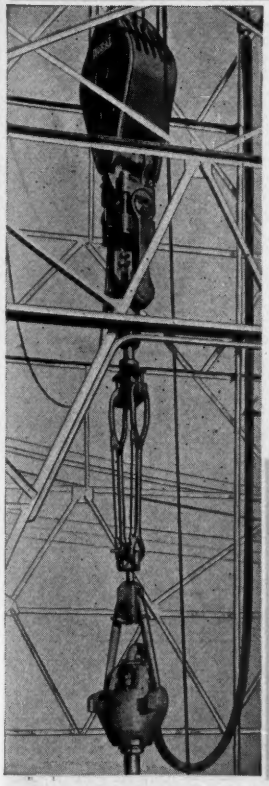
Union Finishes At Brea-Olinda

Union Oil Co. completed Sterns No. 75 on sec. 7-3s-9w in the Brea-Olinda field at effective depth of 3160 ft. pumping 25 gravity oil at a 125 bbl. rate and is drilling No. 76 at 3200 ft., cemented casing at 460 ft. in No. 77 and poured foundation for No. 78.

NATIONAL-IDEAL EQUIPMENT

To Help Speed the Development of New Crude Oil Reserves—

to meet the National Emergency



NATIONAL-IDEAL Oil Field Machinery and Equipment has played a big part in the discovery and development of America's oil fields.

Now National-Ideal units are charged with a new responsibility—that of producing greatly increased volumes of oil for critical war needs at home and on the battle front.

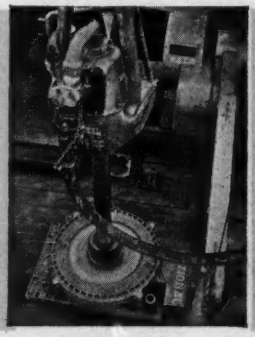
The National-Ideal Machinery that now is in the field, plus what new equipment can be secured, must do this job until the war is over. You must "Serve by Conserving".

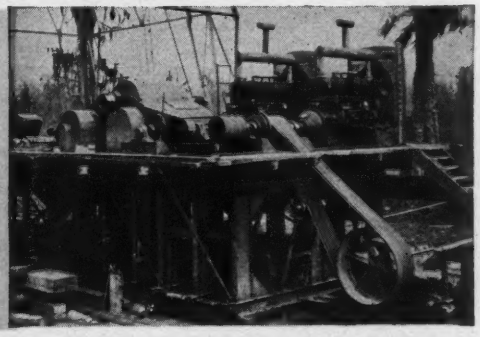
Keep your equipment clean—inspect it regularly—avoid overloads and excessive speeds —lubricate regularly and thoroughly in accordance with manufacturer's instructions—familiarize yourself with the design and construction of your National-Ideal equipment. Ask for free Descriptive Bulletins which will give you this information in detail—call on our Engineering and Service Staffs for consultation regarding equipment problems.

The National Supply Company

Domestic: Executive Offices: Pittsburgh, Penna. • General Sales Office: Toledo, Ohio. • Division Offices: Ft. Worth, Texas; Tulsa, Okla.; Torrance, Calif.

Export: The National Supply Corp., 30 Rockefeller Plaza, New York, N. Y., U.S.A.; River Plate House, 12 South Place, London, E. C. 2, Limited Liability.





Coastal District

Piru Wells Go Ahead

Work in the Piru area proceeds with four strings at work. On sec. 4-4n-18w Pacific Western Oil Corp.'s Temescal No. 14 is drilling in oil sand and shale at 4169 ft. while rig is built for No. 17. Continental Oil Co.'s second Holser well on section 14 of the township is carrying on in lean oil sand and shale at 6050 ft. while Tide Water Assoc. Oil Co.'s Hidden No. 2 on section 5 is drilling in sand and streaks of shale at 6497 ft. after a test of the interval 6224-6302 ft. noted slight showings of oil and gas. Slightly to the north, on sec. 22-5n-18w, Delroy Pet. Corp. is cleaning out Fisk Core Hole No. 3 to continue from present depth of 2808 ft.

Timber Canyon Well Swabbing

A. T. Dennison is swabbing oil and mud to complete his well No. 1 on sec. 13-4n-21w after landing 5 in. perforated liner opposite oil sand and shale on bottom at 2202 ft.

In the nearby South Mountain area F. E. Fairchilid, well known local operator, has acquired the 2750 ft. South Mountain Oil Co. No. 1 on sec. 19-3n-20w and is rigging rotary to deepen.

Cat Canyon To Get Fourth Try

O. C. Field is preparing to start Williams No. 1 near the center of the northwest quarter of sec. 32-9n-32w as the fourth project in the field. The predecessors are located in section 36-9n-33w and are nearing production levels. Deepest is Pacific Western Oil Corp.'s Los Alamos No. 20, now drilling in hard Cherty shale which was entered at 5320 ft. The other projects are Union Oil Co.'s on the Bell lease. No. 16 is making hole in brown shale at 5289 ft. after entering the Miocene at 4190 ft. while foundation has been poured for No. 17.

Rio Vista Gas Wells Completed

Three wells in the Rio Vista Gas field have been added to reserves for heavy industrial and seasonal domestic fuel demands. First completed was the Standard-Texas Co. Midland Fee No. 1-3 on sec. 5-3n-3e which completed at 4260 ft. to flow a 17,793,000 cu. ft. rate through a ¾ in. bean and was shut in under 1625 lbs. pressure. On sec. 32-4n-3e The Texas Co. finished Welch No. 3 at 4270 ft. flowing 7,000,000 cu. ft. daily through a ½ in. bean and was shut in under 1640 lbs. Third of the trio was Amerada Pet. Corp.'s Kuhn Comm. No. 2 on sec. 28-4n-3e which bottomed at 4300 ft. and shut in without a flow trial of sufficient length to determine a rate.

Drillers currently working in the field include Amerada's Sacramento & San Joaquin Drainage District No. 3, which is preparing to complete at 4300 ft., Standard Oil Co.'s State No. 4 on sec. 12-3n-2e, now turning to the right at 750 ft., and Standard's Andrus Island Unit No. 1 which just spudded on sec. 3-3n-3e.

Lodi Gas Well Good Producer

Amerada Pet. Corp., which bottomed its wildcat Lodi Comm. No. 9-1 at 4471 ft. on sec. 9-4n-7e in San Joaquin county, demonstrated gas production on three trials between 2520 and 2590 ft. before plugging to 2270 ft. to complete. Gun perforated in the interval 2240-70 ft. the well blew 5,300,000 cu. ft. of gas through a ⅝ in. bean before being shut in under 934 lbs. pressure.

This substantial production prompted the company to start No. 8-1 on the adjacent section 8 and encouraged Bankline Oil Co. to locate Comm. No. 3-1 on section 5 of the township. Bankline's Galt area wildcat on sec. 1-4n-6e, Comm. No. 1-1, is drilling at 5758 ft. in sand with streaks of shale.

COASTAL COUNTIES WILDCATS

Area	Well	No.	Section	Depth	Status
	Santa Barbara County				
Gato Ridge	General Pet. Corp., Wickenden	2	24, 8-32	3559	Drilling
Goleta	Del Mar Oil Co., Rowe	1	11, 4-28	4230	Abandoning
Lompoc	Alphonzo E. Bell Corp., Lompoc	6	28, 8-34	4997	Pumping
	Ficket Oil Co., Ltd., Well	1	8, 7-33		Rig
Los Olivos	Tide Water A. O. Co., Chamberlin	1	33, 8-31	5194	Pumping
Purisima Hills	Whittier Assoc., Barham	1	11, 7-32		Foundation
	Ventura County				
Bardsdale	San Marino Oil Co. Elkins	1	7, 3-19		Rig
Conejo	L. A. Basin Oil Co., Well	1	4, 1-20	1745	Resuming
	Sycamore Oil Co., Boylan	1	23, 1-20	2747	Idle
Ojai	Coates, Spencer D., Pirie	5	7, 4-22	1033	Abandoned
Piru	Continental Oil Co., Holser	2	14, 4-18	6050	Drilling
	Delroy Pet. Corp., Fisk, C. H.	3	22, 5-18	2808	Cleaning out
	Pac. West. O. Corp., Temescal	14	4, 4-18	4169	Drilling
	T.W.A. Oil Co., Hidden	2	5, 4-18	6497	Drilling
Rincon	Shell Oil Co., Inc., Tomson	1	8, 3-24	5158	Drilling
Santa Paula	J. J. Stevens, Corehole	1	1, 4-20	1336	Drilling
Sespe	McCaslin, W. E. Burson	1	19, 4-19	2039	Idle
	Volunteer Pet. Co., Tar Creek	3	28, 5-19	540	Idle
South Mt.	F. E. Fairfield, S. M.	1	19, 3-20	2750	Rigging up
Timber Canyon	A. T. Dennison, Well	1	13, 4-21	2202	Swabbing
	Crude Oils, Inc., West	1	19, 4-20	958	Idle
	Fletcher & Babcock, O'Leary	1	29, 4-20		Location

NORTHERN COUNTIES WILDCATS

County	Well	No.	Section	Depth	Status
Monterey	Columbia Oil Co., Vierra	1	7, 13s-2e		Rig
Sacramento	Richfield Oil Corp., Natomas	1	17, 10n-4e	4226	Drilling
	Richfield Oil Corp., Natomas	2	28, 10n-4e		Foundation
San Joaquin	Amerada Pet. Corp., Lodi Comm.	9-1	9, 4n-7e	4471	Completed
	Amerada Pet. Corp., Lodi Comm.	8-1	8, 4n-7e	103	Drilling
	Bankline Oil Co., Comm.	1-1	1, 4n-16e	5758	Drilling
San Luis Obispo	W'n Gulf Oil Co., Huasna Comm.	1	35, 31s-14e	2496	Drilling
Solano	Amerada Pet. Corp., Starkey Fee	1	2, 6n-2e	9434	Sampling

Sacramento Co. Try Continues

Richfield Oil Corp.'s Natomas No. 1, sec. 17-10n-4e, recovered a tester lost at 4390 ft. and is spot coring at 4866 ft. No data on test results is obtainable, but some indirect encouragement is given the area since the company has poured foundation for a second Natomas well near the south quarter corner of section 28 of the township.

Amerada Pet. Corp. also scheduled a Sacramento county wildcat, Capitol Co. No. 1, to be drilled in the southeast quarter of sec. 36-5n-5e in the Thornton area.

Ventura Avenue Work Beginning

The long expected upsurge of Ventura Avenue field development is under way. This field represents vast additional reserves of good war-time oils which can be produced, according to good engineering opinion, without damage to future and complete recoveries.

Currently drilling are two strings on the Shell Oil Co., Inc., Taylor lease with several more immediately scheduled. British American Oil Prod. Co.'s Hartmann No. 9 is redrilling, and Lloyd Corp.'s No. 10 project is to be directionally drilled from No. 7's surface location.

Tide Water Assoc. Oil Co. staked five new projects on various leases with Ventura Land & Water Co. No. 56 rigging for an early start. General Petroleum Corp. is building rig for Barnard No. 27 and is preparing ground work for No. 26.

San Miguelito Work Rewarded

Continental Oil Co. Grubb No. 28, sec. 23-3n-24w, which bottomed at 7528 ft. and tested up hole to a plug at 6900 ft., gun perforated the interval 6760-6850 ft. and completed flowing 97 bbls. of clean 30 gravity oil and 200,000 cu. ft. of gas through a 16/64 in. bean. The company has built rig for No. 29 and is preparing to redrill its old No. 2 well on the same lease.

Gato Ridge Well Bailing

O. C. Field's Texas Fee No. 2 on sec. 4-8n-32w is bailing fine silty sand and having trouble cleaning the hole after landing perforated liner on bottom at 2792 ft. On section 9 Barnsdall Oil Co.'s deepening job on Tognazzini No. 6 is delayed while operators mill on a core barrel lost on bottom at 2949 ft.

Solano County "Cat" Re-rigging

Amerada Pet. Corp.'s "No-dope" Starkey Fee No. 1, on sec. 2-6n-2e in the Dixon area, is rigging heavier equipment to resume drilling. Bottomed at 9434 ft., where side wall samples were taken, the well represents the greatest depth ever drilled in the area. No information concerning formation has been afforded the public on this well.

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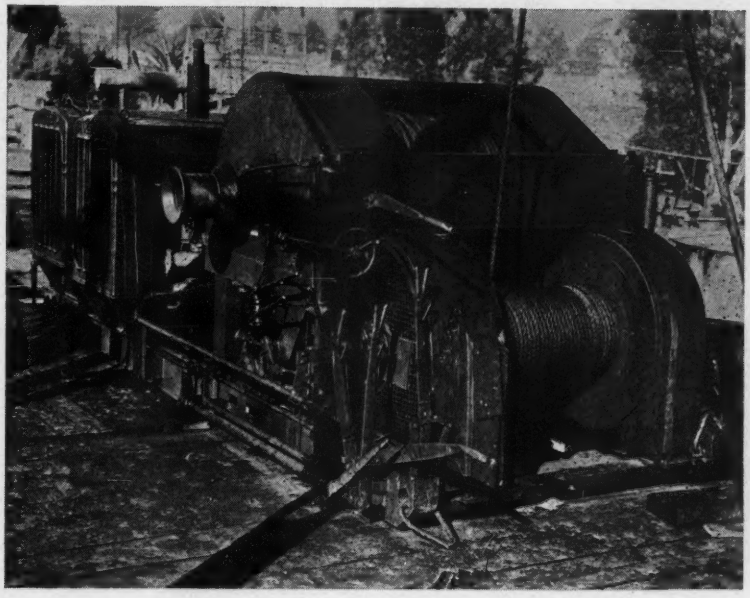

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San Joaquin Valley

Guijarral Hills Wells Near Zone

Two wells seeking production comparable to the discovery in the Guijarral Hills are nearing the potential zone. R. S. Lytle's well No. 88-20F is drilling in Kreyenhagen shale at 7575 ft. while Standard Oil Co.'s Pleasant Valley No. 62-29F is bottomed at 7855 ft. These wells seek the 1000 bbl. production of 28 gravity oil which Standard discovered in No. 82-29F on sec. 29-20s-16e, off the southerly tip of the Coalinga Eocene Pool. The good flow was obtained from 172 ft. of Eocene sands above 9142 ft.

Antelope Hills Try In Hard Gray Sand

C. C. M. O. Co.'s Antelope Fee No. 12-1 is coring hard gray sand at 4668 ft. without having encountered showings. The well seeks to extend the producing area to the center of sec. 12-28s-19e.

South Belridge Well Abandoned

Petromont Oil Corp.'s Petromont-Belridge No. 1, in the southwest quarter of sec. 25-28s-20e, was abandoned at 1518 ft. without showings.

On sec. 20-29s-21e the Los Nietos Co. interests Sheep Springs No. 1 is coring ahead in shale after a formation test of sands cored in the interval 3647-3687 ft. recovered gas cut mud, oily mud and salt water. Honolulu Oil Corp.'s well No. 52 on section 26 is drilling at 1000 ft. in sand and shale.

McKittrick "Cat" Soon To Start

P. H. Frank, Inc., will soon start a wildcat near the south quarter corner of sec. 24-29s-20e. The test is located northwest of the McKittrick field in a comparatively little drilled area where such previous drilling that has been done was only to relatively shallow depths.

Cantua Test Drills Deep

Superior Oil Co.'s Cantua Land No. 54-36, sec. 36-17s-15e, is drilling in undisclosed formation at 9460 ft. No information has been released on this well although it is reported that several sand phases have been taken with no comment on their quality. The age at bottom is not revealed but it must be presumed to be Eocene or older since earlier drilling in the area placed the Eocene at 8900 ft.

On section 14 of the township Richfield Oil Corp.'s shallow test Cantua Co. No. 1 abandoned at 5100 ft. in sandy shale without having recovered either oil or gas on formation trials.

Prep To Pump Jacalitos Try

Standard Oil Co. is rigging pump for production trial on its southerly Jacalitos field outpost well No. 61-35E. Located on sec. 35-21s-15e, the well bottomed at 4415 ft. and landed a 5½ in. combination string including 35 ft. of 60 mesh perforation on bottom. The field produces 39 gravity oil from marine deposits in the Middle Miocene.

Proved Field Work Steadily Progresses

Development of proved acreage in established San Joaquin Valley fields is continuing its normal hard working pace. Currently busiest are South Belridge, Coalinga Old Fields, Buena Vista Hills, Kern Front, Midway-Sunset, Poso Creek, Riverdale and Round Mountain. Other valley fields are getting some new holes and considerable amounts of remedial work, a program expected to increase from moderate to intensive in gait.

SAN JOAQUIN VALLEY WILDCATS

Area	Well	No.	Section	Depth	Status
	Fresno County				
Cantua Creek	Richfield Oil Corp., Cantua Co.	1	14, 17-15	5100	Abandoned
	Superior Oil Co., Cantua-Land	54-36	36, 17-15	9460	Drilling
Jacalitos	Standard Oil Co., Well	61-35	35, 21-15	4415	Rigging pump
Guijarral Hills	Standard Oil Co., Well	62-29F	29, 20-16	7855	Drilling
	R. S. Lytle, Well	88-20F	20, 20-16	7575	Drilling
Wheatville	Superior Oil Co., Kreyenhagen	81-22	22, 17-18	6705	Drilling
	Kern County				
Antelope Hills	C.C.M.O. Co., Antelope Fee	12-1	12, 28-19	4668	Drilling
Belridge	Ernest F. Lang, Well	1	3, 28-20	1830	Drilling
	Petromont Oil Corp.	P-B 1	25, 28-20	1518	Abandoned
Bowerbank	Albert Stevenson, Bowerbank	1	5, 29-24		Location
Comanche Point	T. W. Burnham, Chiquita	2	34, 12-19	2020	Idle
Cymric	Los Nietos Co., Sheep Springs	1	20, 29-21	3960	Drilling
	Honolulu Oil Corp., Well	52	26, 29-21	1015	Drilling
Dyer Creek	D. D. Dunlap, Dyer Creek	1	11, 26-27	2294	Idle
Elk Hills	Pac. West'n & G.F. Getty, McNeil	1	22 30-24		Location
Kern River	O. H. Calhoun, Bridge	1	17 28-28		Location
McKittrick	P. H. Frank, Inc., Well	1	24, 29-20		Location
McVan	Jergins Oil Co. Lambert	1	35, 26-27		Foundation
Midway-SE.	The Texas Co., P.U.P.	2	33, 11-23	10607	Abandoned
Mt. View	DiGiorgio Fruit Corp., Well	4	10, 31-29	5185	Drilling
Round Mt.	Harp & Brown, Olcese	1	17, 28-29		Rigged up
	Signal Pet. Co. of Calif., Mills	1	24, 28-28	1603	Drilling
Strand	T.W.A.O. Co., KCL	76-8	8, 30-26	8370	Drilling
	Kings County				
Hanford	The Texas Co., Souza	1	33, 17-22		Location
Tulare Lake	Shell Oil Co., Inc., T.S.G.	21-28	28, 22-20	11680	Drilling
	Madera County				
Mendota	The Texas Co., Gill	14-16	16, 13-16		Rigging up
	The Texas Co., Gill	38-16	16, 13-16	9154	Completed
Chowchilla	Pure Oil Co., Gamboni	1	28, 10-13		Rigging up
	San Luis Obispo County				
Midway, NW.	C.C.M.O. Co., Thomas	1	1, 31-21	9188	Drilling
	Tulare County				
Pixley	Union-Cont. O. Co., Pacific States	76-25	25, 22-25	4926	Abandoned
Terra Bella	Northern Ordnance, Inc., Campbell	1	22, 22-27		Location

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From the days of Colonel Drake, the oil fraternity's clear vision, unswerving courage and stalwart leadership have overcome such obstacles as lack of finances and equipment, inaccessible locations and transportation difficulties. In war or peace, *the oil man carries on with plenty of courage and baling wire.* And Johnston deems it an honor to be serving an industry which is contributing so much to the development of the world's natural resources.

FORMATION AND CASING TESTING — JOHNSTON

While for the duration armament production must come first, we're continuing our research and development activities so that at the war's end the oil industry will have even finer, more efficient testing equipment than ever before.

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"Why set casing before you know!"

Shell Lake Job Nears 12,000 Ft.

Shell Oil Co., Inc.'s T. S. G. No. 21-28, artificial island located driller on Tulare Lake, is making hole in hard sandy shale at 11,680 ft. This explorer to date has reported no showings or markers. The nearest deep driller on the San Joaquin Valley floor was the company's abandoned Cohn Estate well which encountered the Temblor at 11,100 feet.

Texaco Finishes Mendota Gasser

The Texas Co. which wildcatted the Mendota area of Madera county was rewarded when its 9154 ft. Gill No. 38-16 was completed in Upper Eocene sands from plugged depth of 4485 ft. The well made 11,000,000 cu. ft. of gas through a 43/64 in. bean and was shut in under 1775 lbs. pressure. The company is currently rigging up to start No. 14-16 on the discovery section 16-13s-16e.

Jergins Starts McVan Area Try

Jergins Oil Co. poured foundation for Lambert Lands No. 1 in the northwest quarter of sec. 35-26s-27e. The test lies north of Poso Creek and west of Mount Poso and seeks a fault accumulation in the Vedder.

East Strand Well Testing

Tide Water Assoc. Oil Co., discoverer of East Strand production, is testing its outpost KCL No. 76-8 on sec. 8-30s-26e. The well bottomed at 8370 ft. in hard fine silty sand and cemented 5½ in. casing at 8160 ft. to try showings encountered on the way down. The company's proposed 58-8, for which rig was built, is delayed owing to flooded lease conditions.

Pixley Try Proves Dud

Union Oil Co. and Continental Oil Co. abandoned the joint test, Pacific States No. 76-25, in slate, rubble and conglomerate at 4926 ft. after coring the top of the basement at 4840 ft. Owing to hole conditions the well could not be logged below 4300 ft. Located on sec. 25-22s-25e, the well sought an overlap accumulation in the vast holdings which Conoco originally blocked up.

Stevenson Plans Bowerbank Test

Albert Stevenson, a Long Beach operator, is preparing to drill a gas test in the Bowerbank area of Kern county. The try is to be located in the center of the southeast quarter of sec. 5-29s-24e.

Round Mountain Wildcat Drills

Signal Pet. Co. of Calif. is drilling Mills No. 1, sec. 24-28s-28e, in hard shale at 1605 ft. The well seeks a fault accumulation similar to those comprising the east side producing fields. The company has also graded road and site for McGregor No. 1 on section 26 of the township.

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"Prediction of Suction Limitation When Pumping Volatile Liquids"

(Continued from Page 17)

ence between the bubble point and the apparent vapor pressure for 100 octane gasoline to this factor alone, the vapor volume would be taken at values between 1.01 to 1.02.

Secondly, the slope at which the vapor volume-vapor pressure curve approaches the unit volume coordiant, or liquid state, would have a very definite bearing upon the detection of cavitation in pumping. If this curve approaches the liquid state at a very acute angle, the agreement between bubble point and the apparent vapor pressure as found by cavitation tests will not be as good as when the curve approaches unit volume at a greater angle. The detection of cavitation in general cannot be made to the degree of accuracy with which the bubble point can be determined. We believe that the limiting vapor pressure, or that vapor pressure value to be used to assure cavitation-free operation, is found by the bubble point method.

However, if the bubble point is appreciably higher than the vapor pressure at vapor volumes slightly larger than one, it should be considered practical to use as a limiting vapor pressure the vapor pressures up to relative volume 1.05. It must also be remembered that a slight increase in temperature or a reduction in barometric pressure might result in serious cavitation if no margin of safety has been allowed in the initial determination of pumping conditions. The use of any vapor pressure designation other than bubble point to describe the fuel to be pumped when determining the pumping conditions may lead to serious operating difficulties.

We feel that the application of bubble point method to suction limitation prediction for pumping equipment is entirely practical. While we have established the use of bubble point to correlate the water with 100 octane gasoline cavitation studies, further work should be done to include other blends. However, for the present time this work is not being carried forward at the Pomona Pump Company due to the pressure of the war business. It is hoped that at some future date when world affairs are in better shape that we can continue with this study and perhaps obtain as a part of the pump's specification from refineries buying gasoline pumps the bubble point for the particular conditions at which they expect to have the pumps operate.

We thank you.

Informative Booklet on Catalyst Recovery Compiled by Western Precipitation Corporation

Much valuable information on the recovery of catalyst in the catalytic refining processes that are playing such a vital role in modern aviation gasoline and synthetic rubber production is contained in a new booklet recently compiled by Western Precipitation Corporation, engineers, designers and manufacturers of COTTRELL and MULTICONE equipment.

Early in the development of fluid catalyst refining processes, Western Precipitation engineers were called upon to develop a method of recovering the valuable catalyst from the hot gases in order to make the process economically practical. The first-hand knowledge gained through the resulting research and development work forms the factual background from which this booklet has been compiled. In it are discussed the important phases of catalyst recovery, the types of equipment best suited to each phase, and their methods of operation.

The booklet titled "CATALYST RECOVERY" will be sent gratis to engineers, executives and technical men interested in catalytic refining processes. Write Western Precipitation Corporation, 1048 West Ninth Street, Los Angeles, California.

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PAW Order 4

(Continued from Page 7)

No. 6 of Exhibit "A".

Notwithstanding the provisions of paragraphs (c) (6) and (c) (7) of Petroleum Administrative Order No. 11, no person shall accept delivery of, acquire, or use material to drill, complete, equip, or connect any new well in any pool in the designated area which is marked "E" in Column No. 6 of Exhibit "A" opposite such pool except in conformity with an exception issued by the Petroleum Administration for War in response to an application filed as provided by paragraph (j) of this Order.

(h) **Restriction on Exposing More Than One Pool in Same Wellbore.**

Notwithstanding the provisions of paragraphs (c)(6), (c)(7), and (c)(9) of Petroleum Administrative Order No. 11 or the provisions of this Order, no person shall accept delivery of, acquire, or use material to complete or recomplete any well in the State of California in more than one pool except in conformity with an exception issued by the Petroleum Administration for War in response to an application filed as provided by paragraph (j) of this Order.

(i) **Installation of Pumping or Other Artificial Lifting Equipment.**

Pursuant to paragraph (c)(10) of Petroleum Administrative Order No. 11 and subject to the provisions contained in paragraph (f) thereof, any person may accept delivery of, acquire, or use material for pumping or other artificial lifting equipment to be installed on any oil well in the designated area: **Provided,** that the number of wells on any lease or tract to which pumping or other artificial lifting equipment is attached does not at any time with respect to the productive acreage within the pool in which such well is completed exceed the average well density specified in Column No. 8 of Exhibit "A" opposite the name of such pool: **Provided,** further, that where no well density is prescribed in Column No. 8 of Exhibit "A" for a pool, the provisions of this paragraph (i) shall not extend to such pool.

(j) **Filing of Application for Exceptions.**

All copies of application for exceptions pursuant to paragraphs (c)(10) and (g) of Petroleum Administrative Order No. 11 covering a production operation within PAW District No. 5 together with the information required thereby shall be addressed to:

(1) The District Director of Production, District No. 5, where a crude oil operation including pressure maintenance, repressuring, and secondary recovery operations; or

(2) The District Director of Natural Gas and Natural Gasoline, District No. 5, for a natural gas, natural gasoline or condensate operation.

The application and information shall be filed in **triplicate** with the Petroleum Administration for War, Subway Terminal Building, Los Angeles, California, Ref: PAO 11.

(k) **Violations.**

Any person who wilfully violates any provision of this Order, or who, by any act or omission, falsifies records kept or information furnished in connection with this Order is guilty of a crime and upon conviction may be punished by fine or imprisonment.

Any person who wilfully violates any provision of this Order may be prohibited from delivering or receiving any material under priority control, or such other action may be taken as is deemed appropriate.

(1) This Order shall be effective on and after April 22, 1943. (E.O. 9276, 7 F.R. 10091; E.O. 9125, 7 F.R. 2719; sec. 2(a), Pub. Law 671, 76th Cong., as amended by Pub. Laws 89 and 507, 77th Cong.) Issued this 19th day of April, 1943.

(Sgd.) R. K. Davies
Acting Petroleum Administrator for War.

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Fleming Appointed Transportation Director

The appointment of L. E. Fleming, widely recognized authority on petroleum transportation management and West Coast member of the Tanker Control Board, as director of transportation for district 5 of the Petroleum Administration for War, was announced on April 16, by Deputy Administrator Ralph K. Davies.

Long associated with petroleum transportation and marketing, both in this country and abroad, Mr. Fleming leaves the post of general manager of the transportation department of the Standard Oil Company of California to undertake his new responsibilities for the Petroleum Administration for War.

Upon his graduation from the Universitiy of California in 1915, he joined the Standard Oil Company of New York for whom he was engaged in administrative, marketing and distribution activities in China until the latter part of 1924. In 1925, he joined the staff of the Standard Oil Company of California, with which company he has held several executive positions. He has been general manager of the transportation department since April, 1934.

Mr. Fleming was appointed Pacific Coast industry member of the Tanker Control Board upon its organization in August, 1941, and during the past fourteen months has been chairman of the Navy Contact committee, a sub committee of the district five transportation committee, established to assist the Navy in the solution of Pacific Coast petroleum tanker problems.

Mr. Fleming is a native of Franklin, Pennsylvania, and makes his home in San Francisco.

William Wrather Nominated Geological Survey Head

The nomination of William Embry Wrather, a consulting petroleum geologist of Dallas, Texas, as director of the U. S. Geological Survey was sent to the Senate on April 9 by President Roosevelt. Mr. Wrather at present is serving as associate chief of Board of Economic Warfare's metals and minerals division. He is a former president of A. A. P. G. and was head of A. I. M. E.'s petroleum division in 1933.

RFC Will Extend Credit To Drill Oil Wells

Reconstruction Finance Corporation will make loans available to producers for drilling oil wells to stimulate search for new sources of supply. This was made known in a letter to Senator Joseph C. O'Mahoney, of Wyoming, by Jesse H. Jones of the RFC. Loans will also be made to "refund existing indebtedness to protect a borrower who may be unable to meet his payments due to loss of earnings. . . through lack of necessary priorities."

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Goleta Wildcat Goes on Hook

Del Mar Oil Co.'s Rowe No. 1 on sec. 11-4n-28w in the Goleta area is abandoning in gray Vaqueros sand at 4230 ft. after entering the age at 4108 ft. No showings were encountered in any of the upper horizons.

Engineering, Technology, latest news—twice a month in California Oil World.

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Petroleum Equipment Company Appointed Distributor Bethelehem Pumping Units

The Bethlehem Supply Company of Tulsa, Oklahoma, subsidiary company of the Bethlehem Steel Corporation, has just announced the appointment of the Petroleum Equipment Company, Los Angeles, California, as its Pacific Coast distributor of the Bethlehem Pumping Unit.

California Crude Price Increase Broadened to Cover Other Fields

Price increases, ranging up to 25c a barrel, were extended to other heavy crude fields in California which were not covered by Amendment 87 on March 26. This action was taken in Amendment 93 to RPS 88 issued by OPA and effective April 12. As in amendment 87, OPA provided that maximum price for a higher gravity crude shall not be less than that for a lower gravity crude in the same pool. Wheeler Ridge, in the amendment, was added to OPA's No. 6 group fields (Capitan, South Mountain, Santa Paula), which were granted similar increases in Amendment 87. A typographical error on 14-14.9 gravity Olinda and Brea Canyon crudes was corrected to 95c per barrel. It was previously given as 97c.

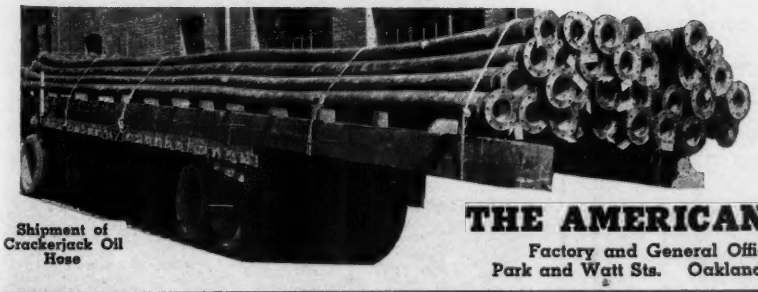
Oil Workers are War Workers.

C. P. Watson

Watson Reelected President Oil Producers Agency

Oil Producers Agency of California held its annual meeting on April 21st at the Biltmore Hotel, and elected the following officers: President, C. P. Watson, Seaboard Oil Co.; 1st Vice Pres., L. A. Cranson, Honolulu Oil Corp.; 2nd Vice Pres., Wm. C. Whaley, Barnsdall Oil Co.; 3rd Vice Pres., H. E. Woodward, Safe Oil Co.; 4th Vice Pres., Robert Garrison, Hellman Estate; Exec. Vice Pres., Rush M. Blodget; Secretary, W. A. Russell, Seaboard Oil Co.; Asst. Secy., Verne Harrell, Bankline Oil Co. Three new directors were added to the Board. They are as follows: O. D. Knight, operator; Richard A. Grant, Fullerton Oil Co.; R. W. Sherman, British American Oil Prod. Co.

CRACKERJACK OIL HOSE



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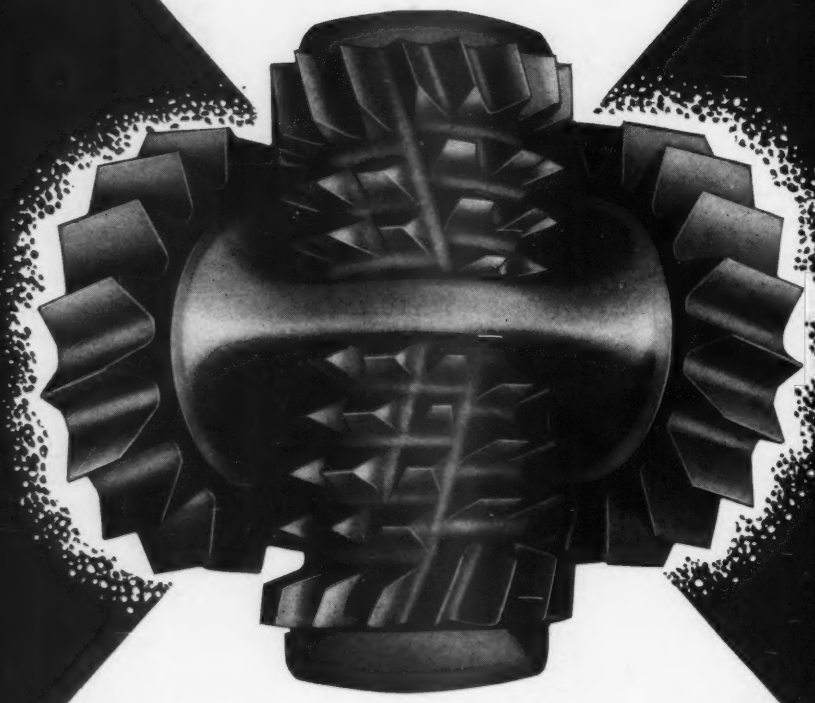

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Administrative Highlights •

OPA Rejects Crude Price Increase

Price Administrator Brown on May 4 rejected a general increase in crude oil prices, but announced a plan for extending federal financial aid to "wildcat" operators to promote exploration for oil. Mr. Brown, in a letter to Mr. Ickes, dated May 1, stated that after "thorough consideration of all factors involved" he had reached the following conclusions:

1. That the general average increase of crude oil price ceilings as proposed should not be granted. 2. That specific relief may be given to producers where stripper or repressure operations make present production unprofitable. 3. That increased incentives may be extended to promote exploration of oil. 4. That full development of proven properties should be insured through "other necessary action under existing powers."

Mr. Brown proposed a plan under which the Government would furnish capital through existing banking facilities to operators for wildcat operations. In return for such an investment the Government would receive one-fourth override interest in any well proving to be a commercial producer. If the well proved to be a dry hole, the override interest would be worthless and any obligation in connection with funds so advanced would be discharged. In the case of a producing well, the operator would have the option of permitting the one-fourth override to stand or of liquidating such interest on the basis of $7 for every $1 advanced. The advance through such a plan, the Price Administrator said, would be limited to a maximum of two-thirds of the estimated cost of drilling the well subject to revision upwards or downwards when final figures are available. The remainder of the cost would be handled by the operator through the sale of acreage, bottom or dry hole money and personal assets.

"Under the plan duly qualified operators could and would undertake wildcat drilling to any degree deemed necessary or advisable and in contrast to a general price increase all funds made available would be used strictly in exploring for new reserves," said Mr. Brown. In case the well proved to be a producer and additional funds were required for completion, these would be available on a dollar for dollar repayment basis, Mr. Brown explained.

The Petroleum Industry War Council, meeting in Washington, rejected the proposal of Mr. Brown to subsidize the drilling of wildcat wells rather than grant a 35-cent over-all increase in the price of crude oil. The Council requested its committee on price adjustments to prepare an answer to Mr. Brown's proposals. It is understood the answer reaffirms the industry's stand against subsidy and in favor of a general increase as the only solution to forcing up the discovery rate.

Oil Enforcement Rules Told

California oil operators were told that along with the wide freedom given them in mapping their explorations for oil, they now will have the responsibility of strictly following the new rules.

Orders announced recently gave Herbert R. Gallagher, director of the Petroleum Administration for War for the West Coast district, administration authority over oil production operations here, and also relieved the oil men from many restrictions formerly in force upon exploratory drilling.

Streamlining of action against those who violate PAW orders or regulations was announced by Administrator Harold L. Ickes in Washington. Explaining the need for the newly simplified procedures, Ickes said:

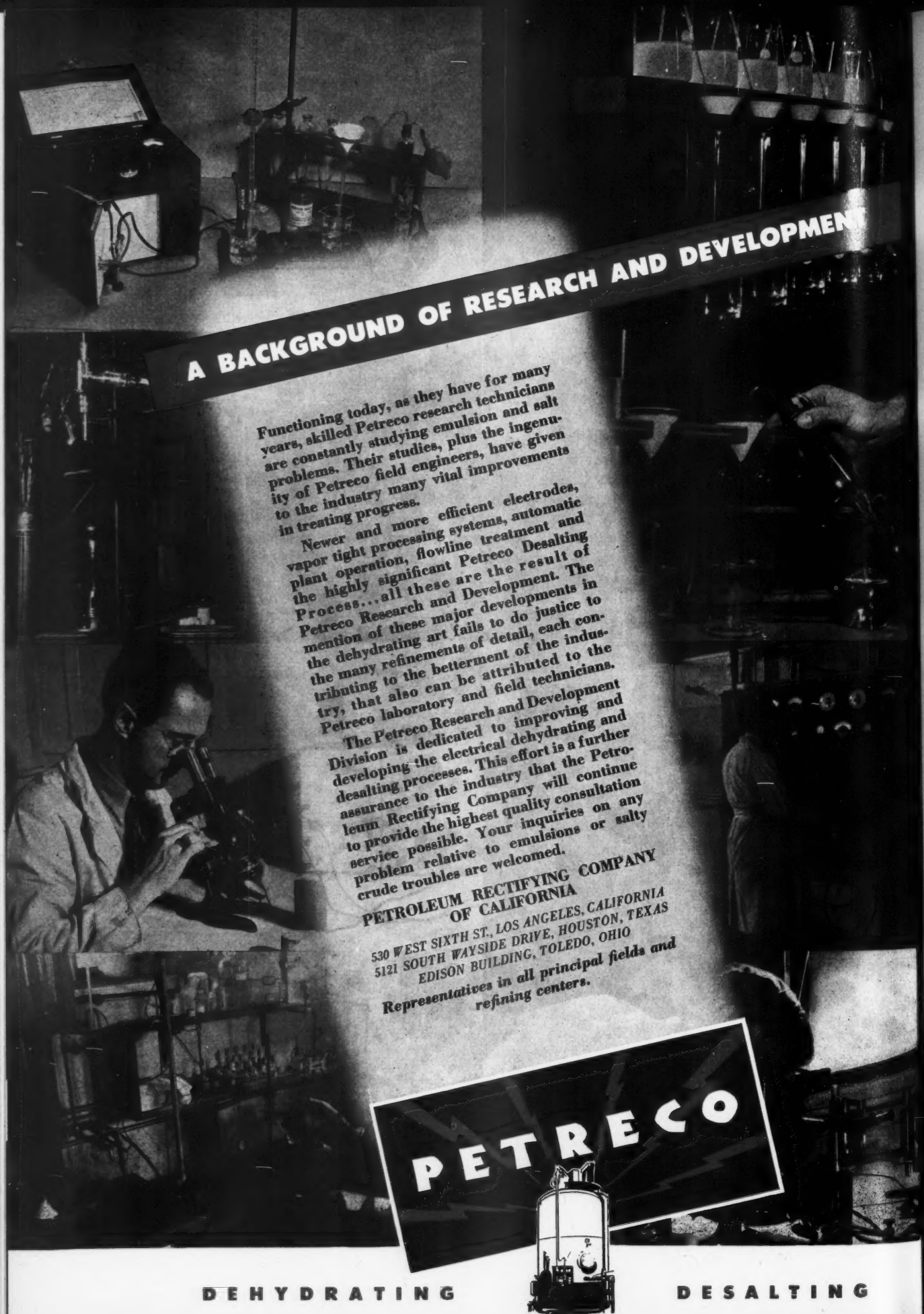
"It is an effort to make as simple as possible the investigation and handling of any violation of an order or directive issued under the authority given to the PAW by the executive order of the President. In principle, the procedure conforms with the accepted practice of the War Production Board and its handling of compliance matter.

"Emphasis is placed on the need for continued cooperation by the petroleum industry with this office in order that non-compliance penalties will be avoided."

Deputy Petroleum Administrator Ralph K. Davies explained the administration of the non-compliance proceeding. He said:

"We have been gratified by the support which the petroleum industry has accorded the various PAW orders. Compliance proceedings have been comparatively few in number. However the necessity exists for a clearly defined compliance procedure and the one issued by the Petroleum Administrator will meet this requirement.

"A non-compliance proceeding is started with a letter from the compliance section in PAW, outlining the known facts to the company or operator who, it is believed has



A BACKGROUND OF RESEARCH AND DEVELOPMENT

Functioning today, as they have for many years, skilled Petreco research technicians are constantly studying emulsion and salt problems. Their studies, plus the ingenuity of Petreco field engineers, have given to the industry many vital improvements in treating progress.

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The Petreco Research and Development Division is dedicated to improving and developing the electrical dehydrating and desalting processes. This effort is a further assurance to the industry that the Petroleum Rectifying Company will continue to provide the highest quality consultation service possible. Your inquiries on any problem relative to emulsions or salty crude troubles are welcomed.

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violated a Petroleum Administrator order, directive or regulation.

"The company or operator can reply in writing or may elect to present the facts at a conference before a commissioner appointed by PAW.

"If a conference is requested, the commissioner listens to the presentation of facts and then prepares for the compliance section a report of such facts. The company or operator is given a copy of this report and has the right to make any reply necessary.

"When all facts or arguments are thus presented the entire matter is submitted to an assistant deputy Petroleum Administrator, who reviews the file and makes a recommendation to the Petroleum Administrator or the Deputy Petroleum Administrator.

"If it is determined that no violation exists the company or operator is notified immediately. If a violation has in fact been committed an appropriate suspension or enforcement order is issued by the Petroleum Administrator or the Deputy Petroleum Administrator."

This order may contain one of the following penalties:

1. Withdrawing or withholding priorities assistance.

2. Withdrawing or withholding allocations of scarce materials.

3. Prohibiting a respondent from delivering, receiving, using or otherwise dealing in specified scarce materials or products.

4. Such provisions which may be found necessary and appropriate to accomplish the purpose of the executive order creating the Petroleum Administration for War.

Production Operation Notices Shall Be Filed with PAW

Herbert R. Gallagher, Director in Charge of District Five, Petroleum Administration for War, has advised operators that before commencing a production operation in California under authority of Petroleum Administration Order No. 11, Supplementary Order No. 4, any exception thereto or other authorization thereunder, they shall file with the Petroleum Administration for War a copy of any notice which is now required by the State law of California to be filed with the Division of Oil and Gas. These notices are "Notice of Intention to Drill New Well", Form No. 105; "Notice of Intention to Deepen, Redrill, Plug or Alter Casing", Form No. 107; and "Supplementary Notice", Form No. 123.

Copies of such notices shall be delivered or mailed to the District Director of Production, Petroleum Administration for War, 855 Subway Teminal Building, Los Angeles, California.

Sizes of Tubular Oil Goods Cut by WPB

To help meet the increased demands for oil country tubular goods used in the production of petroleum products and gas, the War Production Board on April 30th issued a simplification schedule which cuts in half the number of permitted sizes and specifications.

Schedule 9 to order L-211 (national emergency specifications for steel products) limits the production of oil tubular goods to a list of 168 items, based largely on a simplified list developed some time ago by the American Petroleum Institute. Formerly, more than 3000 items were produceed by the industry.

The schedule is expected to result in a tubular goods production increase of about 15 per cent and ease the burden placed on mills by requirements for pipelines, munitions and other essential equipment.

The term "oil country tubular goods" means oil well casing, tubing, and drill pipe. The schedule makes exceptions for oil well casing produced by electric fusion welding; for orders entered prior to April 30th, provided delivery is made before June 30; and in certain cases, for items with special thread dimensions or types of joints.

Southlander Named to Washington Post

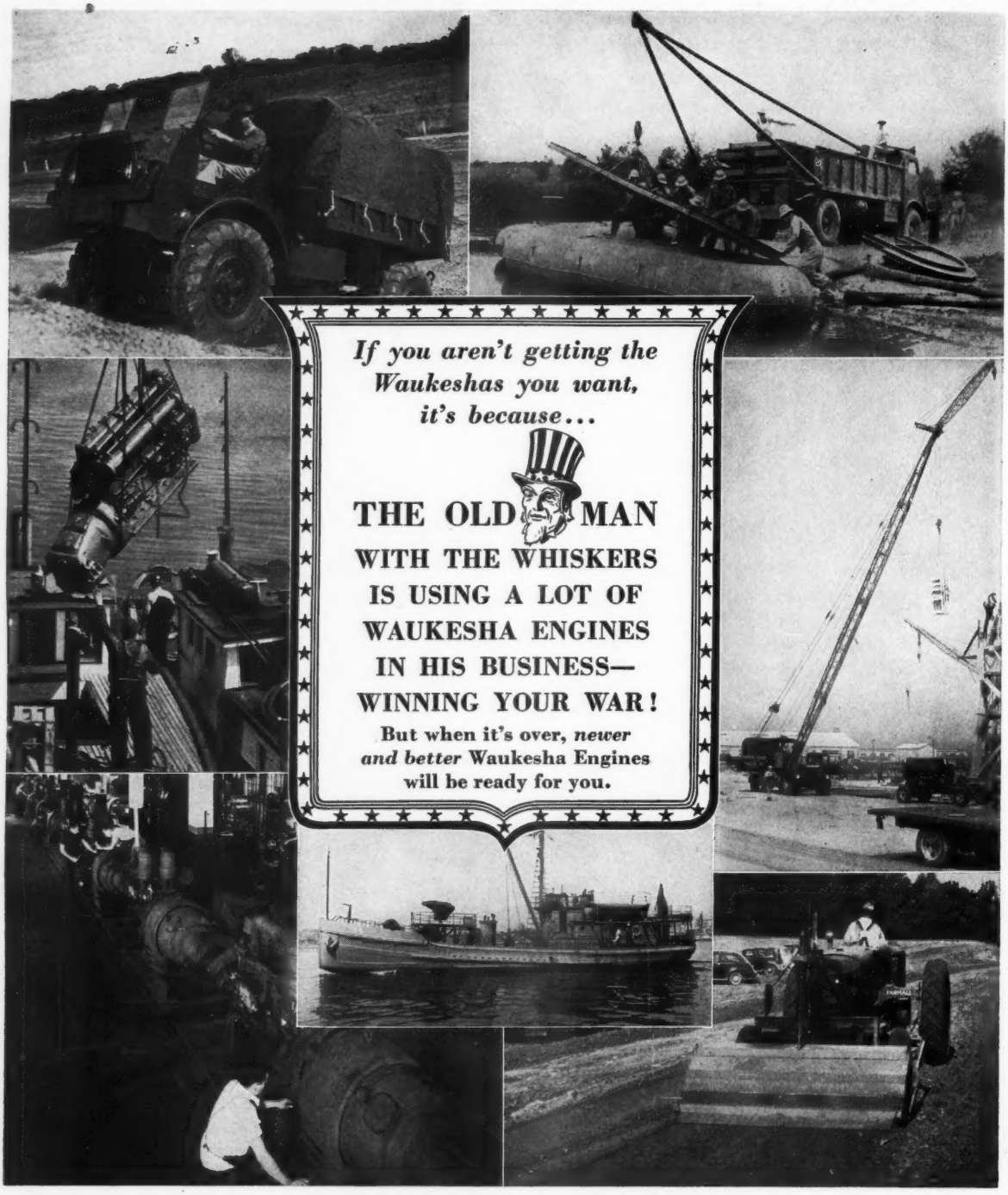
Allen A. Jergins, prominent Southland oil man, was named director to the Petroleum Administration for War's facility security division in Washington.

Announcement of Jergins' appointment was made on May 4th by Harold L. Ickes, PAW director, following the resignation of William D. Mason, Philadelphia oil executive, to return to his former position in private industry from which he had been "borrowed."

Jergins has become well known here, as vice-president of the San Joaquin Valley Oil Producers Association; vice-chairman of the oil industry protection committee of California (an industry committee formed immediately after the attack on Pearl Harbor to take protective measures for the oil fields and plants of California), member of the western region committee of Petroleum Industry War Council Committee on protection of petroleum facilities, vice-president and director of Jergins Oil Company, president of Monterey Exploration Company and vice-president and director of Lomita Gasoline Company.

Oil and Gas Leases on Public Domain May Be Unitized

A plan of unitization of oil or gas leases on public domain was proposed by the Interior Department. The proposed regulation was issued by the department on April 10 but will not be effective until interested parties have informed the Geological Survey of their opinions of the regulation. Sixty days was allowed for filing of comments. Hearings may be held later. The proposed regulation calls for cooperative agreements among operators to operate on a unit basis, designating one of their number as a unit operator who would be subject to a supervisor representing Interior Department. Each agreement would be effective 5 years.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Volumetric and Viscosity Studies of Gas and Oil from the Santa Maria Valley Field

By R. H. Olds, B. H. Sage, Member A.I.M.E., and W. N. Lacey

Abstract

Determinations were made of the viscosity of the liquid phase and of the volume of mixtures of gas and liquid samples from the production trap of a well in the Santa Maria Valley field in California. Measurements were made at 100°, 190°, and 250°F. and at pressures up to 5000 lb. per square inch.

Introduction

In recent years a reasonable quantity of experimental data has been accumulated concerning the volumetric behavior and the viscosity of hydrocarbon systems. One of the main objectives for such work is the attempt to predict the properties of naturally occurring hydrocarbon mixtures under the conditions encountered in nature. At the present time the volumetric behavior of homogeneous hydrocarbon mixtures can be predicted with reasonable accuracy within certain ranges of composition[1-5] over a relatively wide range of temperature and pressure. Heterogeneous systems offer a more difficult problem. The viscosity of both simple and complex hydrocarbon mixtures has been investigated in some detail.[5,6] Nevertheless, information regarding this property is as yet insufficient to permit dependable forecasts for many cases of practical interest. For this reason a study of the volumetric behavior and the viscosity of the liquid phase of several mixtures of oil and gas from the Santa Maria Valley field was carried out.

The work included the determination of the specific volume, at temperatures of 100°, 190°, and 250°F., of the trap liquid and of four mixtures of this constituent[7] with the coexisting trap gas from a surface separator in this field. These measurements were extended to pressures of 4000 lb. per sq. in. The viscosity of three mixtures of the trap samples was ascertained at 100°, 190°, and 250°F., for pressures up to 5000 lb. per sq. in. It is believed that these data are sufficient to establish the volumetric behavior and the viscosity of the liquid phase of homogeneous and heterogeneous mixtures of the trap samples at pressures somewhat above 3000 lb. per sq. in., at the temperatures mentioned, for gas-oil ratios below 1000 cu. ft. per barrel.

It is further believed that studies of this nature are of value in connection with the development of quantitative methods of predicting the volumetric behavior and the viscosity of the liquid phase of hydrocarbon mixtures, especially when combined with similar information for binary and ternary hydrocarbon systems.

TABLE 1.—*Composition of Trap Samples*

Component	Gas		Liquid	
	Mol Fraction	Weight Fraction	Mol Fraction	Weight Fraction
Methane	0.7511	0.5264	0.00889	0.00038
Ethane	0.0959	0.1260	0.01032	0.00084
Propane	0.0813	0.1566	0.03322	0.00395
Isobutane	0.0124	0.0315	0.00991	0.00155
n-butane	0.0266	0.0675	0.03629	0.00569
Isopentane	0.0065	0.0205	0.01962	0.00382
n-pentane	0.0060	0.0189	0.02709	0.00527
Carbon dioxide	0.0140	0.0269		
Fractions	130–291[a]			0.05062
	291–403			0.05493
	403–481			0.05768
	481–502			0.05925
	502–511			0.05952
	Residue			0.69650
Hexanes and heavier	0.0062[b]	0.0257	0.85466[c]	0.97850
Gas-oil ratio, cu. ft. per bbl.				7.055

[a] Distillation range, deg. F.
[b] Assumed average molecular weight, 95.0.
[c] Average molecular weight determined by freezing-point lowering of benzene extrapolated to infinite dilution of solute, 424.7.

TABLE 2.—*Properties of Hexanes-and-heavier Portion of Trap Liquid Sample*

Mol fraction of trap liquid sample 0.85466
Weight fraction of trap liquid sample 0.97850
Gravity, 60°F., atmospheric pressure 0.9606
Specific volume, 60°F., atmospheric pressure 0.016692
Kinematic viscosity, centistokes: 100°F., 1005; 122°F., 500.
Viscosity-gravity factor: 0.898
Average molecular weight 424.7[a]

Cut No.	Specific Gravity, 60°F.	Kinematic Viscosity, Centistokes		Viscosity Gravity Factor	Distillation Range, Deg. F.	Weight[b] Fraction
		77°F.	100°F.			
1	0.739	0.67	0.58	0.786	130–291	0.05062
2	0.802	1.21	1.02	0.832	291–403	0.05493
3	0.842	2.40	1.90	0.852	403–481	0.05768
4	0.865	3.41	2.55	0.868	481–502	0.05925
5	0.869	3.56	2.68	0.871	502–511	0.05952
Residue	1.017	690[c]	250[d]	0.953		0.69650

[a] Determined from freezing point lowering of benzene extrapolated to infinite dilution of solute. Measured at this laboratory.
[b] Based upon entire trap liquid sample.
[c] 180°F.
[d] 210°F.

TABLE 3.—*Composition of Tank Oil*[a]

Component	Mol Fraction	Weight Fraction
Methane	0.00	0.00
Ethane	0.00575	0.00046
Propane	0.02875	0.00336
Isobutane	0.00943	0.00145
n-butane	0.03794	0.00584
Isopentane	0.02138	0.00409
n-pentane	0.02576	0.00492
Hexanes and heavier	0.87100	0.97988

[a] Gravity at 60°F. = 17.9°A.P.I.

Glossary of Terms

In order that a more specific meaning may be ascribed to a word or phrase than is normally associated with it, a number of the more frequently used terms will be defined. The terms "trap gas" and "trap liquid" refer to the gas and liquid phases in the surface separator from which the samples were drawn. The expression "tank oil" is applied to the sample that is typical of hydrocarbon fluid delivered to the stock tank of the well in question. The composition of this material undoubtedly changes with the trapping conditions, but the results obtained, based on this material, are at least descriptive of the situation in the field at the time of sampling. The formation volumes reported are based upon the composition of the tank oil and are expressed in terms of the volume of the phase, or phases, in equilibrium at the prescribed conditions,

TABLE 4.—*Specific and Formation Volumes for Trap Liquid Sample*

Pressure, Lb. per Sq. In. Abs.	100°F.		190°F.		250°F.	
	Specific Volume, Cu. Ft. per Lb.	Formation Volume	Specific Volume, Cu. Ft. per Lb.	Formation Volume	Specific Volume, Cu. Ft. per Lb.	Formation Volume
	(41.4)[a]		(71.7)		(130.2)	
B.P.	0.01731	1.0241	0.01794	1.0609	0.01835	1.0856
100	0.01730	1.0233	0.01793	1.0606		
200	0.01729	1.0226	0.01792	1.0597	0.01834	1.0848
400	0.01726	1.0210	0.01788	1.0578	0.01830	1.0824
600	0.01724	1.0197	0.01785	1.0559	0.01827	1.0804
800	0.01722	1.0184	0.01782	1.0541	0.01823	1.0783
1000	0.01720	1.0172	0.01779	1.0523	0.01820	1.0762
1250	0.01717	1.0157	0.01775	1.0500	0.01815	1.0738
1500	0.01715	1.0143	0.01772	1.0480	0.01812	1.0715
1750	0.01712	1.0128	0.01768	1.0459	0.01808	1.0694
2000	0.01710	1.0115	0.01765	1.0440	0.01804	1.0671
2250	0.01708	1.0102	0.01762	1.0422	0.01801	1.0650
2500	0.01705	1.0086	0.01759	1.0405	0.01797	1.0630
2750	0.01703	1.0071	0.01756	1.0386	0.01794	1.0611
3000	0.01700	1.0055	0.01753	1.0368	0.01791	1.0593
3250	0.01697	1.0038	0.01750	1.0351	0.01788	1.0573
3500	0.01694	1.0022	0.01747	1.0334	0.01784	1.0554
3750	0.01692	1.0007	0.01744	1.0316	0.01781	1.0535
4000	0.01689	0.9990	0.01741	1.0298	0.01778	1.0516

[a] Figures in parentheses are bubble-point pressures expressed as pounds per square inch absolute.

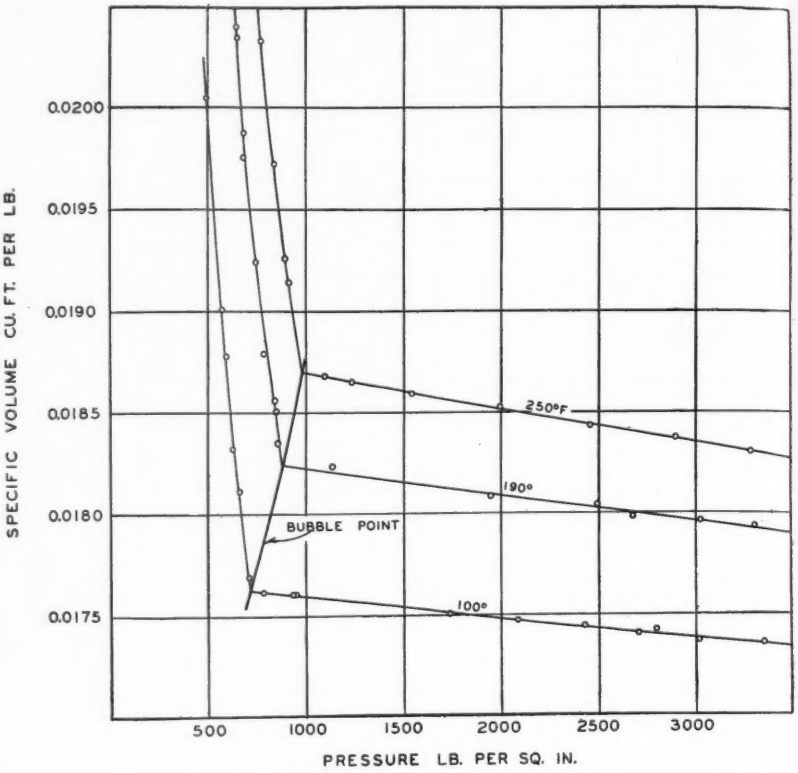

Fig. 2—Specific volume-pressure diagram for mixture containing 0.0189 weight fraction trap gas.

and associated with a unit volume of tank oil as measured at 60°F. and 14.73 lb. per sq. in. The gas-oil ratio is reported on the basis of the tank oil, and is expressed as cubic feet of gas per barrel of tank oil, both phases being measured at 60° F. and 14.73 lb. per sq. inch.

The hydrocarbon samples employed in this investigation were obtained from the liquid and gas phases in a surface separator, the site being a well in the Santa Maria Valley field. Both the liquid and the gas phases were dried by passage through beds of granular calcium chloride. In the procurement of these samples, conventional precautions were observed in order to avoid flashing of the trap liquid during the filling of the container. Sub-samples from the primary containers were taken for analytical purposes.

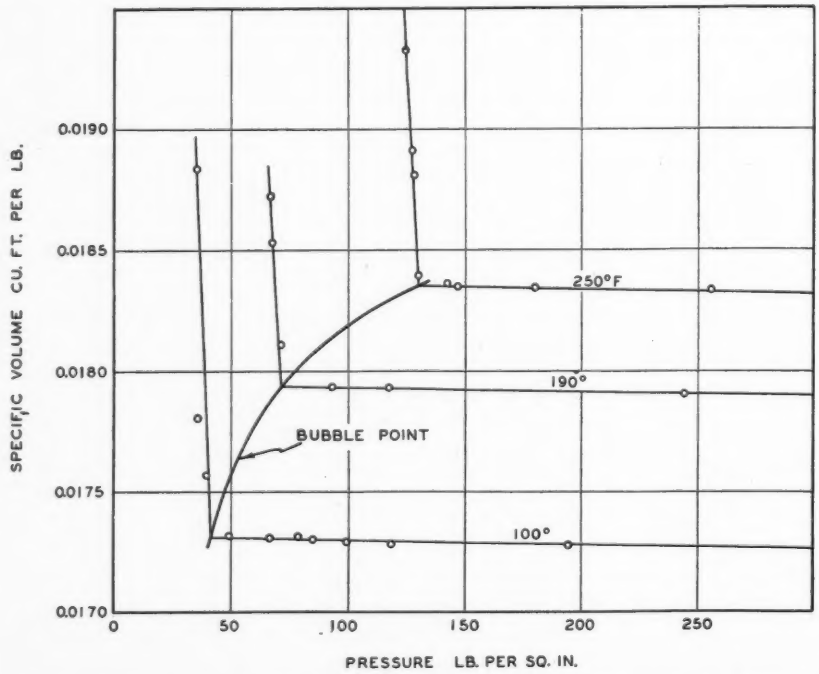

Fig. 1—Experimental results for trap liquid samples in vicinity of bubble point.

The results of the analyses of the trap samples are recorded in Table 1. In this connection the mol fractions of the paraffin hydrocarbons, from methane through npentane, were determined for both the trap gas and trap liquid samples. The hexanes-and-heavier portion of the trap liquid samples was divided into fractions by a suitable distillation process carried out at reduced pressures. The distillation range of each fraction, together with its corresponding weight fraction, is indicated in Table 1. A number of properties of these fractions are recorded in Table 2. The composition of the tank oil is shown in Table

TABLE 5.—*Composition of Experimentally Studied Mixtures*

Weight fraction trap gas	0.01890		0.04993		0.07995		0.12890	
Component	Weight Fraction	Mol Fraction	Weight Fraction	Mol Fraction	Weight Fraction	Mol Fraction	Weight Fraction	Mol Fraction
Methane	0.01033	0.18548	0.02665	0.35027	0.04244	0.44289	0.06818	0.53267
Ethane	0.00320	0.03068	0.00708	0.04968	0.01084	0.06036	0.01697	0.07072
Propane	0.00683	0.04466	0.01157	0.05533	0.01615	0.06133	0.02363	0.06715
Isobutane	0.00212	0.01051	0.00305	0.01106	0.00395	0.01137	0.00541	0.01167
n-butane	0.00685	0.03398	0.00877	0.03183	0.01063	0.03062	0.01366	0.02945
Isopentane	0.00413	0.01650	0.00465	0.01359	0.00515	0.01195	0.00596	0.01036
n-pentane	0.00553	0.02207	0.00595	0.01739	0.00636	0.01476	0.00703	0.01220
Hexanes, and heavier[a]	0.00049[b]	0.00147	0.00128	0.00285	0.00206	0.00362	0.00332	0.00438
	0.96001[c]	0.65132	0.92966	0.46156	0.90027	0.35491	0.85237	0.25152
Carbon dioxide	0.00051	0.00333	0.00134	0.00644	0.00215	0.00819	0.00347	0.00988
Gas-oil ratio[d]	111.43		293.06		480.43		813.70	

[a] Average molecular weight, gas = 95.0; liquid = 424.7.
[b] Hexanes and heavier from trap gas.
[c] Hexanes and heavier from trap liquid.
[d] Gas-oil ratio expressed in cubic feet per barrel of tank oil.

3. Experimental work upon the hexanes-and-heavier portion from the tank oil indicated that it can be assumed to be identical with the hexanes-and heavier portion of the trap liquid sample, as far as could be ascertained by the usual physical tests. A recent compilation of the physical properties of the paraffin hydrocarbons[8] has been employed in the calculations associated with Tables 1, 2, and 3.

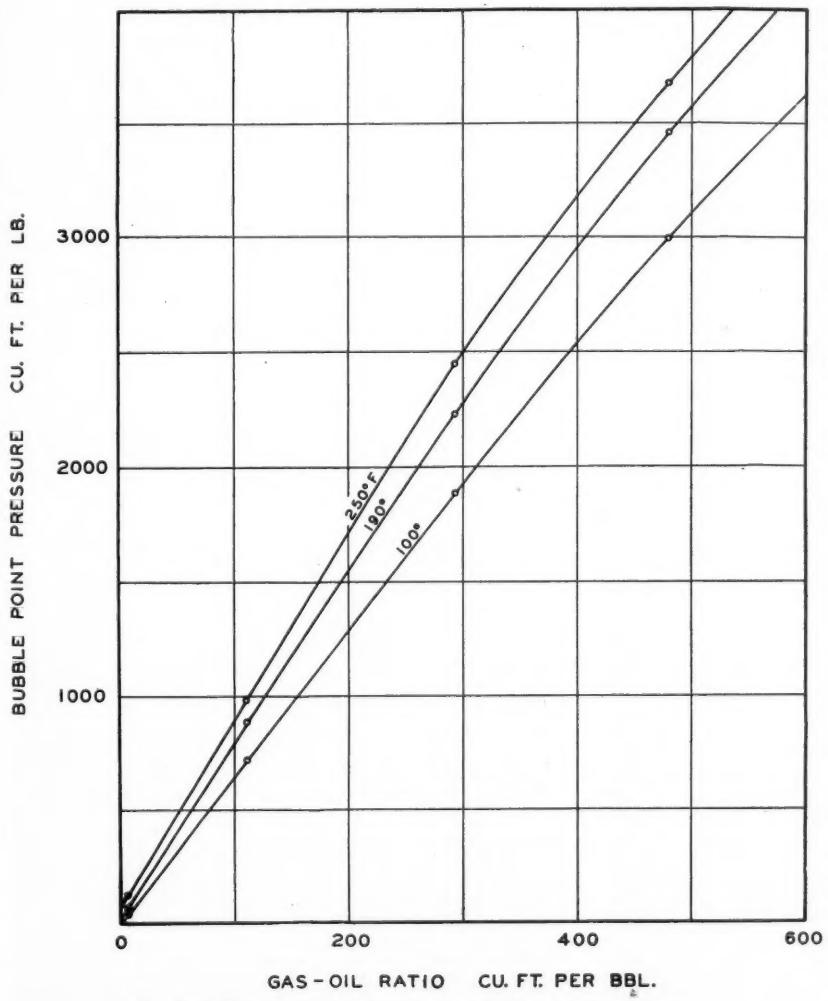

Fig. 3—Influence of gas-oil ratio upon bubble-point pressure.

Volumetric Studies

The volumetric behavior of the trap liquid sample was established at 100°, 190°, and 250°F. The influence of pressure upon the specific volume of the trap liquid sample

TABLE 6.—*Volumetric Behavior of Experimentally Studied Mixtures*

Pressure, Lb. per Sq. In. Abs.	100°F.		190°F.		250°F.	
	Specific Volume, Cu. Ft. per Lb.	Formation Volume	Specific Volume, Cu. Ft. per Lb.	Formation Volume	Specific Volume, Cu. Ft. per Lb.	Formation Volume
Weight Fraction Trap Gas = 0.01890; Gas-oil Ratio = 111.43						
B.P.	(720)[a]		(887)		(982)	
200	0.01761	1.062	0.01824	1.100	0.01870	1.128
400	0.03375	2.035	0.04150	2.502	0.04820	2.906
600	0.02223	1.340	0.02568	1.548	0.02850	1.718
800	0.01867	1.125	0.02095	1.263	0.02278	1.374
1000	0.01760	1.061	0.01883	1.135	0.02011	1.213
1250	0.01758	1.060	0.01821	1.098	0.01870	1.127
1500	0.01755	1.058	0.01818	1.096	0.01865	1.125
1750	0.01753	1.057	0.01814	1.094	0.01861	1.122
2000	0.01750	1.055	0.01812	1.092	0.01856	1.119
2250	0.01748	1.054	0.01808	1.090	0.01852	1.117
2500	0.01745	1.052	0.01806	1.089	0.01848	1.114
2750	0.01743	1.051	0.01803	1.087	0.01844	1.112
3000	0.01741	1.050	0.01800	1.085	0.01840	1.109
3250	0.01739	1.048	0.01796	1.083	0.01836	1.107
3500	0.01736	1.047	0.01793	1.081	0.01831	1.104
3750	0.01734	1.046	0.01790	1.079	0.01827	1.102
4000	0.01732	1.044	0.01787	1.077	0.01824	1.099
	0.01730	1.043	0.01784	1.076	0.01820	1.097
Weight Fraction Trap Gas = 0.04993; Gas-oil Ratio = 293.06						
B.P.	(1886)		(2230)		(2450)	
200	0.01819	1.133	0.01887	1.175	0.01931	1.202
400	0.07465	4.648	0.09175	5.712	0.1058	6.584
600	0.04050	2.521	0.04835	3.010	0.05448	3.392
800	0.02983	1.857	0.03480	2.167	0.03880	2.416
1000	0.02494	1.553	0.02859	1.780	0.03156	1.965
1250	0.02229	1.388	0.02520	1.569	0.02755	1.715
1500	0.02033	1.266	0.02275	1.416	0.02452	1.527
1750	0.01919	1.195	0.02119	1.319	0.02260	1.407
2000	0.01847	1.150	0.02013	1.253	0.02131	1.327
2250	0.01818	1.132	0.01937	1.206	0.02037	1.268
2500	0.01815	1.130	0.01886	1.174	0.01968	1.225
2750	0.01812	1.128	0.01882	1.172	0.01929	1.201
3000	0.01809	1.126	0.01878	1.169	0.01924	1.198
3250	0.01806	1.125	0.01875	1.167	0.01919	1.195
3500	0.01804	1.123	0.01871	1.165	0.01914	1.192
3750	0.01801	1.121	0.01867	1.163	0.01910	1.189
4000	0.01799	1.120	0.01864	1.160	0.01905	1.186
	0.01797	1.119	0.01860	1.158	0.01901	1.183

in the vicinity of the bubble point is shown in Fig. 1. It is apparent that the specific volume of the bubble-point liquid increases, at diminishing rate, with increase in bubble-point pressure. The volumetric behavior of the trap liquid sample is recorded in Table 4, for the several temperatures investigated. The information includes the specific volume and the formation volume as functions of pressure.

The compositions of the experimentally studied mixtures are given in Table 5. These data were obtained from the relative quantities of the trap samples introduced into the apparatus, and the information

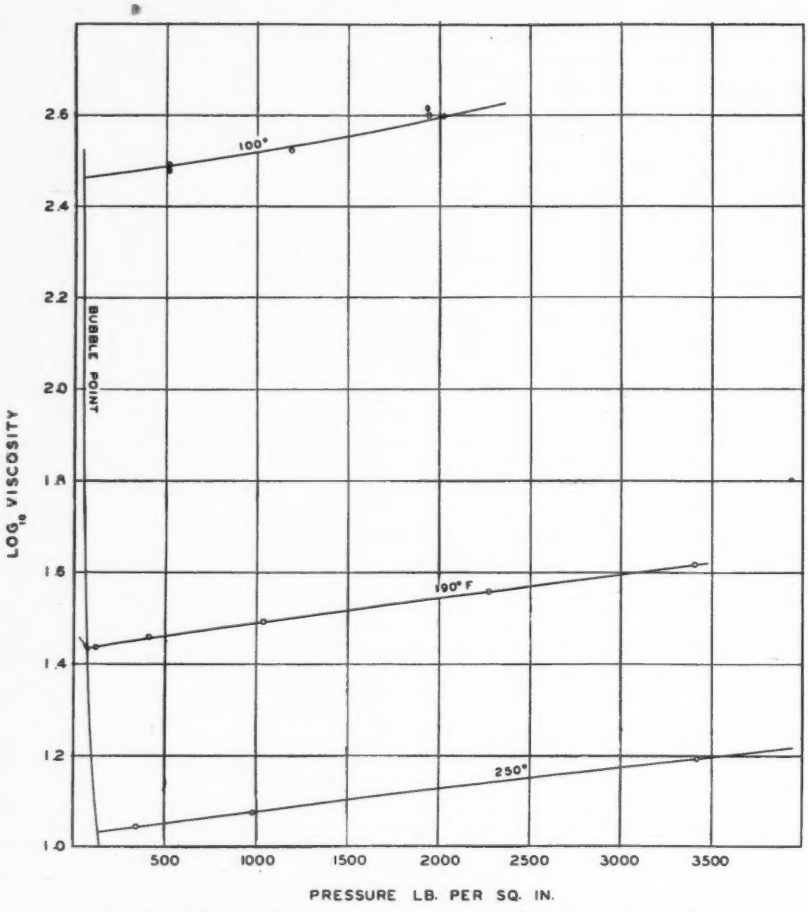

Fig. 4—Influence of pressure upon viscosity of trap liquid sample.

in Table 1 and 3. The influence of pressure upon the specific volume of a mixture containing 0.0189 weight fraction trap gas, corresponding to a gas-oil ratio of 111.4 cu. ft. per barrel, is shown in Fig. 2. The density of the experimental points is typical of that obtained for the other mixtures investigated. The curvature of the bubble-point locus is reversed for this mixture, compared with the behavior of the trap liquid sample shown in Fig. 1. This variation in the influence of pressure upon the specific volume of bubble-point liquid is in accord with the conduct of other naturally occurring hydrocarbon systems.

The volumetric behavior of the four mixtures investigated is recorded in Table 6. Both the specific volume and the formation volume have been shown as functions of pressure and temperature. The bubble-point pressures have been indicated for all mixtures, with the exception of the one corresponding to a gas-oil ratio of 813.7.

The experimental results were smoothed with respect to composition, and the properties of the bubble-point liquid were obtained by suitable graphical interpolation. The composition and volumetric behavior of this fluid are recorded in relation to pressure for 100°, 190°, and 250°F., in Table 7. The influence of the gas-oil ratio upon the bubble-point pressure of mixtures of the trap samples is shown in Fig. 3.

The results obtained yield an almost linear relationship of formation volume to gas-oil ratio throughout the heterogeneous region covered by this experimental work. Diagrams of the formation volume as a function of gas-oil ratio were not included in this discussion, since their value lies primarily in permitting direct utilization in interpolative procedures. However, the information included in Tables 6 and 7 aids in the preparation of such diagrams with a minimum of effort.

Viscosity Studies

The viscosity of the trap liquid sample and of three mixtures of trap samples was determined as a function of pressure at 100°, 190°,

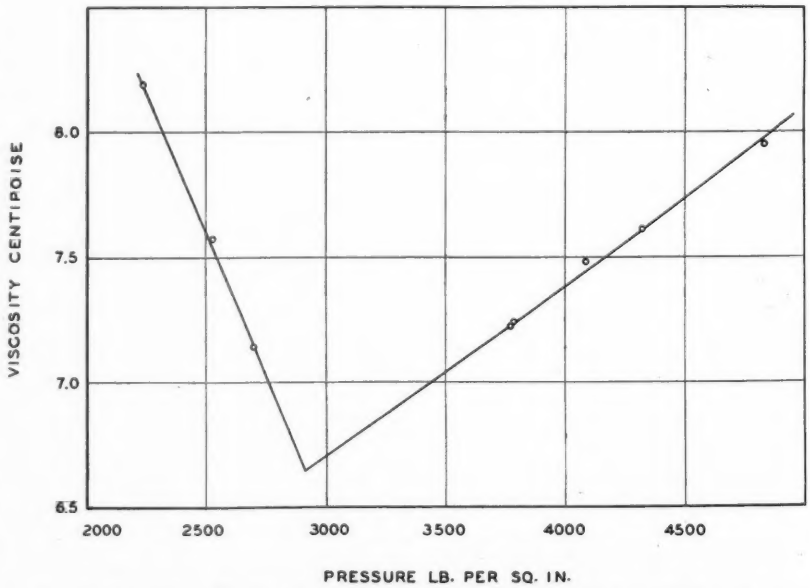

Fig. 5—Viscosity at 190°F. of liquid phase of mixture containing 0.0665 weight fraction trap gas.

TABLE 6.—(*Continued*)

Pressure, Lb. per Sq. In. Abs.	100°F. Specific Volume, Cu. Ft. per Lb.	100°F. Formation Volume	190°F. Specific Volume, Cu. Ft. per Lb.	190°F. Formation Volume	250°F. Specific Volume, Cu. Ft. per Lb.	250°F. Formation Volume
Weight Fraction Trap Gas = 0.07995; Gas-oil Ratio = 480.43						
	(3000)		(3464)		(3679)	
B.P.	0.01876	1.206	0.01951	1.255	0.01993	1.281
600	0.03923	2.522	0.04790	3.080	0.05367	3.450
800	0.03189	2.050	0.03835	2.466	0.04274	2.748
1000	0.02763	1.776	0.03280	2.109	0.03628	2.333
1250	0.02442	1.570	0.02858	1.838	0.03140	2.019
1500	0.02249	1.446	0.02585	1.662	0.02817	1.811
1750	0.02120	1.363	0.02400	1.543	0.02593	1.667
2000	0.02033	1.307	0.02276	1.463	0.02428	1.561
2250	0.01969	1.266	0.02169	1.395	0.02305	1.482
2500	0.01932	1.242	0.02096	1.348	0.02217	1.425
2750	0.01902	1.223	0.02043	1.314	0.02147	1.380
3000	0.01876	1.206	0.02004	1.288	0.02094	1.346
3250	0.01873	1.204	0.01974	1.269	0.02051	1.319
3500	0.01870	1.202	0.01951	1.254	0.02016	1.296
3750	0.01867	1.199	0.01948	1.252	0.01992	1.281
4000	0.01865	1.197	0.01945	1.250	0.01989	1.279
Weight Fraction Trap Gas = 0.12890; Gas-oil Ratio = 813.70						
400	0.08050	5.466				
600	0.05549	3.768	0.06846	4.649	0.07753	5.265
800	0.04331	2.941	0.05298	3.597	0.05965	4.051
1000	0.03622	2.459	0.04398	2.987	0.04926	3.345
1250	0.03086	2.095	0.03701	2.513	0.04114	2.794
1500	0.02749	1.866	0.03253	2.209	0.03593	2.440
1750	0.02525	1.714	0.02953	2.005	0.03240	2.200
2000	0.02371	1.610	0.02737	1.858	0.02988	2.029
2250	0.02267	1.540	0.02579	1.751	0.02799	1.900
2500	0.02204	1.497	0.02455	1.667	0.02653	1.802
2750	0.02169	1.473	0.02374	1.612	0.02542	1.726
3000	0.02155	1.463	0.02319	1.575	0.02454	1.667

[a] Figures in parentheses are bubble-point pressures, expressed as pounds per square inch absolute.

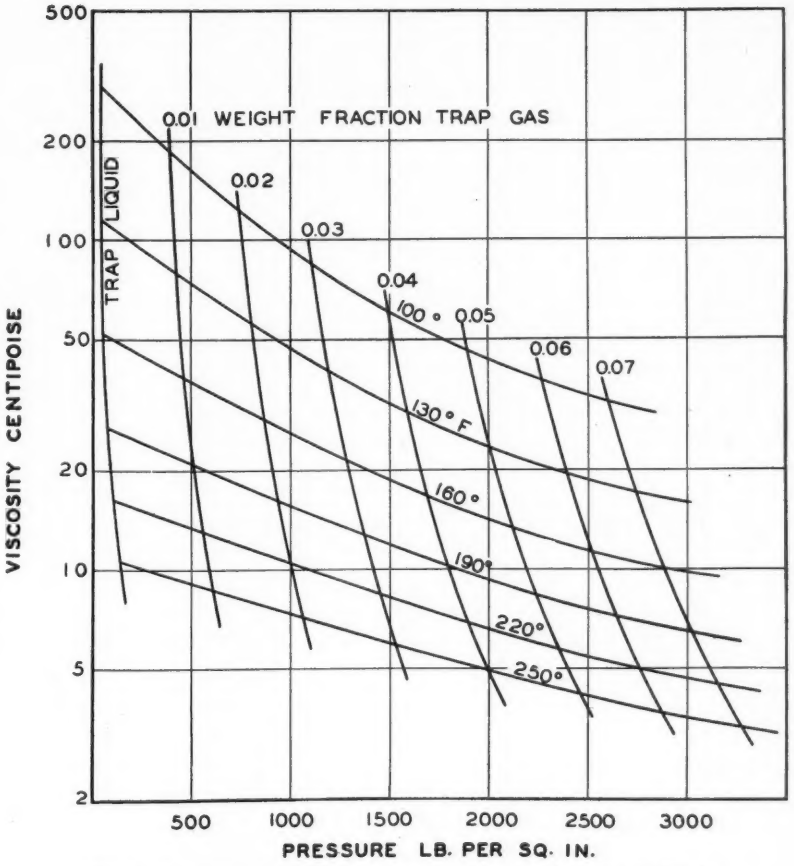

Fig. 7—Influence of pressure upon viscosity of bubble-point liquid.

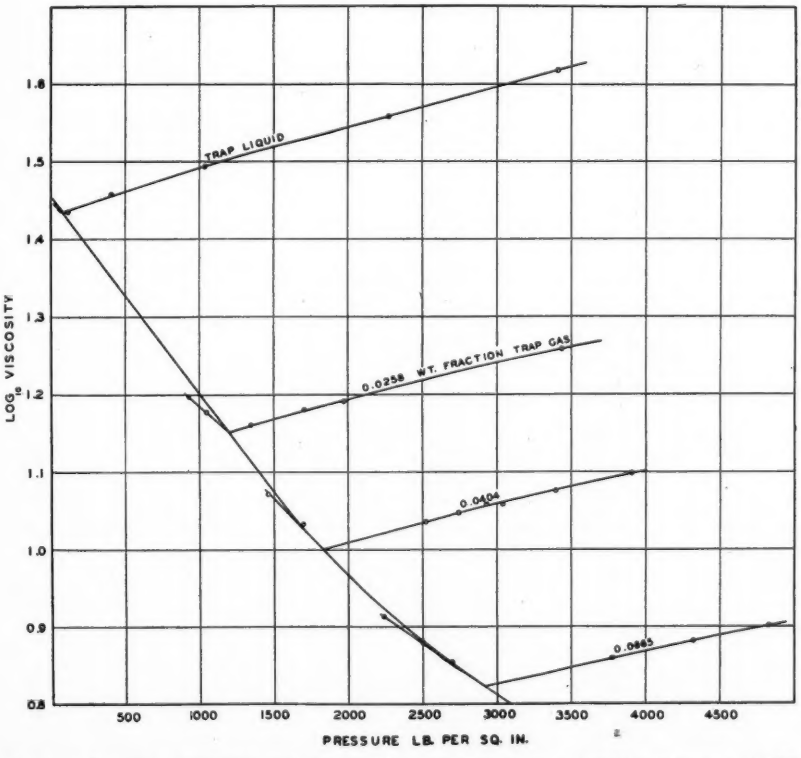

Fig. 6—Influence of pressure and composition upon viscosity of liquid mixtures at 190°F.

and 250°F. The results of this experimental work are recorded in Table 8, which presents the viscosity of liquid phase of mixtures of the designated composition as a function of pressure for these temperatures. The influence of pressure upon the viscosity of the trap liquid sample is visualized in Fig. 4. The scale is such that it was impossible to show the behavior in the heterogeneous region, except by the single bubble-point curve. The data show that the viscosity of the liquid phase of a mixture reaches a minimum at bubble point.

The viscosity at 190°F. of the liquid phase of a mixture corresponding to a gas-oil ratio 393 cu. ft. per barrel is indicated in Fig. 5. The sharply defined minimum at bubble point is clearly evident. The points shown were obtained both upon increase and decrease of pressure, thus indicating that equili-

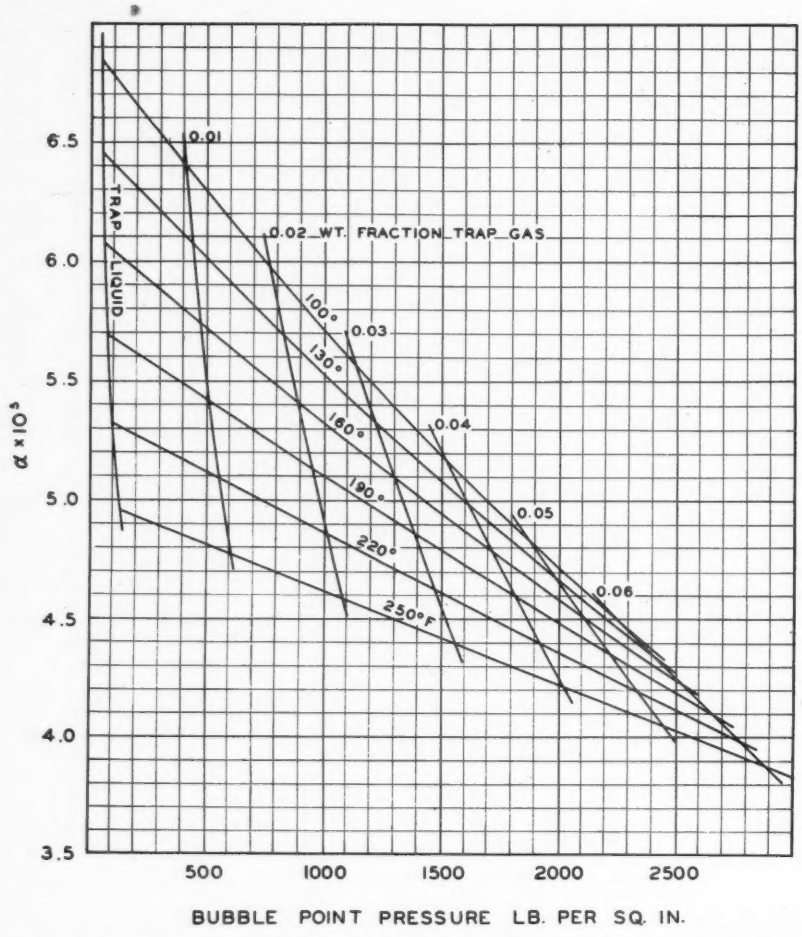

Fig. 8—Influence of temperature, composition, and bubble-point pressure upon logarithmic viscosity-pressure coefficient.

brium was attained with reasonable accuracy.

The influence of pressure and composition upon the viscosity of the liquid phase of the restricted multicomponent system, made up of mixtures of the trap samples, is shown in Fig. 6, for a temperature of 190°F. The experimental results were smoothed, and the influence of pressure and temperature upon the viscosity of the bubble-point liquid was obtained as a result of these graphical operations. The viscosity of this fluid is recorded as a function of temperature and pressure in Table 9. These data are presented in Fig. 7, and the behavior at several intermediate temperatures has been included, to facilitate interpolation. A logarithmic scale has been employed in order to present the data to better advantage. Lines of constant composition expressed as weight-fraction trap gas have been included.

The influence of pressure upon the viscosity of the condensed liquid phase is marked, but direct interpolation of the experimental data is difficult. For this reason the information has been correlated in terms of a coefficient that is related to the viscosity of the condensed liquid and that of the bubble-point liquid in the following manner:

$$\log n = \log n_b + \alpha(P - P_b) \qquad [1]$$

The coefficient α is shown in Fig. 8 as a function of bubble-point pressure and temperature. For the purpose of the present correlation, it was found possible to neglect the influence of pressure upon this coefficient, thereby simplifying it to a marked extent. As a matter of interest, lines of constant composition have been included in this diagram, as was done in Fig. 7. Eq. 1 is relatively simple to use, and permits calculation of the viscosity of the condensed liquid phase, at any pressure within range of this experimental work, from a knowledge of the state and the bubble-point pressure or composition.

Nomenclature

- n Viscosity, centerpoises.
- n_b Viscosity of bubble-point liquid, centipoises.
- P Pressure, lb. per sq. in. absolute.
- P_b Bubble-point pressure, lb. per sq. in. absolute.
- α Coefficient in Equation I.

Acknowledgments

This experimental work was made possible by financial assistance from the General Petroleum Corporation, the Richfield Oil Corporation, the Texaco Development Corporation, and the Union Oil Company of California, jointly. The authors are grateful to these corporations for permission to publish the results. The assistance of Louise M. Reaney, in the calculations and preparation

TABLE 7.—*Properties of Bubble-point Liquid*

Pressure, Lb. per Sq. In. Abs.	Weight Fraction Trap Gas	Gas-oil Ratio, Cu. Ft. per Bbl.	Specific Volume, Cu. Ft. per Lb.	Formation Volume
		100°F.		
400	0.0101	61	0.01750	1.046
600	0.0157	92	0.01759	1.057
800	0.0211	123	0.01767	1.067
1000	0.0265	153	0.01777	1.080
1250	0.0332	193	0.01789	1.094
1500	0.0398	232	0.01800	1.109
1750	0.0465	271	0.01811	1.123
2000	0.0532	312	0.01821	1.137
2250	0.0598	352	0.01832	1.153
2500	0.0666	394	0.01845	1.169
2750	0.0733	437	0.01859	1.187
3000	0.0800	481	0.01876	1.206
		190°F.		
600	0.0121	72	0.01812	1.085
800	0.0166	98	0.01820	1.095
1000	0.0211	123	0.01829	1.105
1250	0.0270	157	0.01839	1.118
1500	0.0329	190	0.01850	1.131
1750	0.0387	225	0.01860	1.145
2000	0.0445	259	0.01871	1.158
2250	0.0505	295	0.01888	1.176
2500	0.0565	331	0.01900	1.191
2750	0.0626	369	0.01910	1.205
3000	0.0687	408	0.01925	1.223
		250°F.		
600	0.0099	59	0.01858	1.110
800	0.0141	82	0.01863	1.118
1000	0.0183	107	0.01870	1.127
1250	0.0236	137	0.01880	1.139
1500	0.0288	167	0.01890	1.151
1750	0.0342	198	0.01900	1.164
2000	0.0397	230	0.01910	1.176
2250	0.0454	265	0.01920	1.190
2500	0.0511	299	0.01931	1.204
2750	0.0571	335	0.01943	1.219
3000	0.0631	373	0.01955	1.234

TABLE 8.—*Viscosity of Experimentally Studied Mixtures*

CENTIPOISES

Pressure, Lb. per Sq. In. Abs.	Weight Fraction Trap Gas = 0.000; Gas-oil Ratio = 7.1			Pressure, Lb. per Sq. In. Abs.	Weight Fraction Trap Gas = 0.0258; Gas-oil Ratio = 150		
	100°F.	190°F.	250°F.		100°F.	190°F.	250°F.
B.P.	(41.4)[a] 290.7	(71.7) 27.17	(130.2) 10.73		(954) 100.00	(1200) 14.17	(1358) 6.38
200	296.3	27.70	10.85	1000	100.69		
400	304.1	28.51	11.10	1250	103.70	14.26	
600	311.7	29.32	11.38	1500	106.73	14.72	6.50
800	321.0	30.10	11.64	1750	110.03	15.22	6.69
1000	330.8	30.89	11.91	2000	113.58	15.70	6.89
1250	343.6	31.92	12.26	2250	117.08	16.16	7.08
1500	358.9	32.92	12.63	2500	121.34	16.59	7.26
1750	375.8	34.03	13.00	2750	125.84	16.99	7.44
2000	394.5	35.00	13.40	3000	130.56	17.41	7.61
2250		36.07	13.78	3250	135.52	17.82	7.76
2500		37.14	14.16	3500	140.93	18.20	7.91
2750		38.28	14.54	3750			8.07
3000		39.45	14.91				
3250		40.72	15.33				
3500			15.74				

Pressure, Lb. per Sq. In. Abs.	Weight Fraction Trap Gas = 0.0404; Gas-oil Ratio = 236			Pressure, Lb. per Sq. In. Abs.	Weight Fraction Trap Gas = 0.0665; Gas-oil Ratio = 393		
	100°F.	190°F.	250°F.		100°F.	190°F.	250°F.
B.P.	(1520) 59.23	(1825) 10.01	(2030) 4.92	B.P.	(2498) 34.29	(2910) 6.65	(3137) 3.50
1750	60.39			2500	34.30		
2000	61.97	10.22		2750	34.93		
2250	63.68	10.51	5.02	3000	35.66	6.71	
2500	65.49	10.79	5.13	3250	36.37	6.87	3.54
2750	67.45	11.10	5.25	3500	37.24	7.04	3.61
3000	69.50	11.39	5.37	3750	38.14	7.21	3.69
3250	71.65	11.72	5.49	4000	39.08	7.38	3.76
3500	73.69	12.05	5.62	4250	40.09	7.56	3.84
3750	75.86	12.37	5.75	4500	41.07	7.73	3.91
4000	78.27		5.87	4750	42.17	7.91	3.99
4250			5.99	5000	43.43	8.11	4.08

[a] Figures in parentheses represent bubble-point pressures in pounds per square inch absolute.

of the figures, and that of H. A. Taylor, in the experimental measurements, is acknowledged.

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TABLE 9.—*Viscosity of the Bubble-point Liquid*

CENTIPOISES

Pressure, Lb. per Sq. In. Abs.	100°F.	130°F.	160°F.	190°F.	220°F.	250°F.
200	238.89	99.08	46.94	25.06	15.52	10.33
400	187.07	81.92	40.68	22.33	14.11	9.50
600	146.69	68.05	35.23	19.86	12.81	8.71
800	116.52	56.96	30.45	17.72	11.58	7.99
1000	93.84	47.75	26.42	15.81	10.55	7.38
1250	73.96	38.80	22.26	13.78	9.37	6.66
1500	60.23	32.07	18.76	12.00	8.33	6.03
1750	50.44	27.00	16.10	10.53	7.39	5.47
2000	43.43	23.50	14.04	9.35	6.64	4.96
2250	38.14	20.81	12.41	8.32	6.00	4.53
2500	34.12	18.79	11.26	7.59	5.49	4.17
2750	30.91	17.25	10.40	6.95	5.04	3.86
3000		15.96	9.75	6.44	4.68	3.59
3250				6.01	4.35	3.36

Nomads April Meeting

Two speakers of note entertained the Los Angeles Chapter of Nomads at the regular monthly dinner meeting held in Los Angeles, Wednesday evening, April 14, 1943. The dinner was preceded by a business meeting which was presided over by Henry W. Pullman, president of the Chapter.

T. M. Johnston, Master of Ceremonies for the evening, introduced the first speaker, Dr. Elmer S. Nelson, who talked on "Price Control and Post-War Economics." Dr. Nelson was appointed by President Wilson as economic advisor to the government in 1918 and since that time has served on the War Trade Board, War Industries Board, U. S. Food Administration and U. S. Shipping Board. Later he was professor of economics at the University of California and is now on the staff of the O. P. A. in California.

Great interest was shown in an address by Dr. E. B. L. Cunningham on "Our Enemies the Japanese." This speaker was well qualified to discuss the Japanese since he practiced medicine for many years in Tokio and has lived in both Japan and China. At one time he was chairman of the American Committee of The Merchants' Association of Tokio and was one of the founders of the American Club in Tokio. At present he is president and director of the Lewellyn Biological Institute, having returned to the United States just when war was breaking out.

There were many visitors at the meeting from all parts of the United States as well as from foreign countries. Among these were Chester Naramore, assistant secretary of the A. I. M. E. from New York, Al Dill of the New York Chapter of Nomads and C. E. Whitney of the Houston Chapter. The guests from foreign countries included Ernest H. Smith of Casoc from Arabia; Harry S. Condor from Trinidad; C. C. Sutton of Caribbean Petroleum Company, Maracaibo, Venezuela; and Chet Cassel, formerly with The Texas Company in Venezuela.

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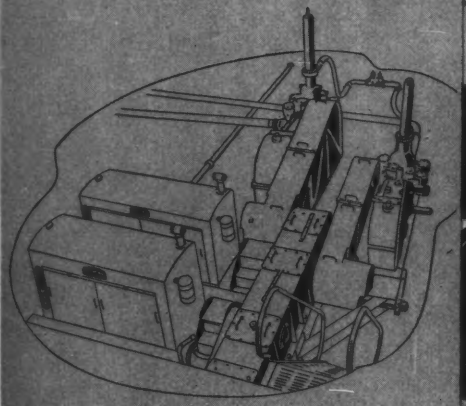

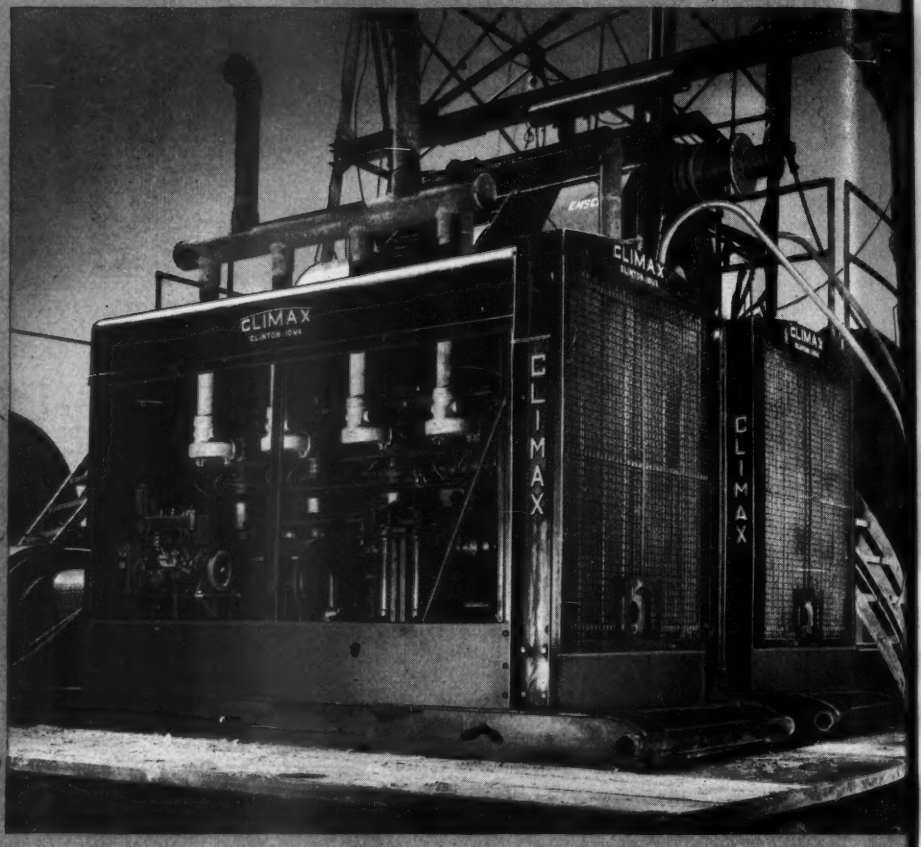

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Field Development

Los Angeles Basin

L. A. City Well Abandoning

Shell Oil Company Inc.'s Verne Community No. 1 at First and Gardner Streets in the metropolitan area of the City of Los Angeles is abandoning at 7924 feet. Drilled as a modern day trial of deep sands in the old Salt Lake City field, the well is reported to have found scant saturation in the old shallow sands and nothing in the deep Miocene objective. No official reports are available but it is believed that steep dips were encountered at bottom and that further development of the area will be postponed. The difficulties of drilling in this heavily congested residential district were multiple. To overcome official objections the company employed electric drilling equipment housed in a fume-noise-odor proof covered derrick and further isolated the driller from sight by a tight high fence around the location.

Newport Beach Well Produces

D. W. Elliott's Townsend Land Co. No. 1 was cleaned out and recompleted pumping 38 bbls. of 14 gravity clean oil after making an initial estimated 50 bbls. and sanding up. Located immediately northeast of the mouth of the Santa Ana River and the Coast Highway, the wildcat bottomed at 2366 ft. in heavy oil sands reported comparable to those taken in the old Newport Beach field some distance to the east. With 8⅝ in. casing cemented over the zone at 2304 ft. the test is reported maintaining its production rate.

Plans are, however, going forward to deepen the test while the drilling equipment is still installed. Certainly no better time is available to determine the thickness of the producing horizon at low cost.

Brea-Olinda Well Pumps Large Yield

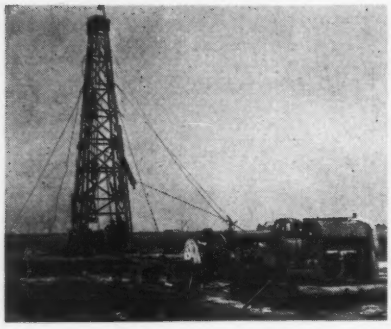
Union Oil Co.'s Sterns No. 76 on sec. 7-13-9w in the Brea-Olinda field proved a prolific pumper from 3858 ft.. With 307 ft. of perforations open the well made 616 bbls. of 24.5 gravity clean oil and 288,000 cu. ft. of gas during its first 24 hour gauge. On nearby No. 77 the company landed 6⅝ in. combination pipe on a plug at 3345 ft. to complete after bottoming in gray sand at 4100 ft. and has built rig for No. 78 in continuation of its drilling program.

Carrey Well Employs Unique Rotary Rig

A. A. Carrey, Long Beach geologist who is drilling Meyer No. 1 on sec. 16-6s-10w in the Costa Mesa area, is using the smallest completely equipped rotary drilling rig in the country. Built by Young Brothers Supply Co. of Signal Hill some 14 months ago, the outfit has seen continuous use with several projects slated immediately ahead. Perfectly proportioned the rig is V-8 powered to drive a 17 in. rotary table at 200 rpm with circulation maintained through a 6¾ x 12 pump. The rig is designed to drill to 2300 ft. and as an indication of its strength has already landed 1400 ft. of heavy 8⅝ in. casing on a prior job. For service work where upper hole bridges must be drilled out the rig is extremely serviceable for in addition to drilling out, the easily installed outfit will carry some 6000 ft. of sand line on its drum.

LOS ANGELES BASIN WILDCATS

Area	Well	No.	Section	Depth	Status
Aliso Canyon	Standard Oil Co., Frew	1-1	29, 3-16		Location
Del Valle	Standard Oil Co., N.L. & F.	3-1	19, 4-17		Location
La Mirada	The Texas Co., McNally	A-3	22, 3-11	9535	Abandoned
Las Llajas	Western Gulf Oil Co., Brady	1	13, 3-17	9610	Drilling
L. A. City	Shell Oil Co., Inc., Verne Comm.	1	24, 1-13	7924	Abandoning
Montebello	Cont. Oil Co., Baldwin	1	3, 2-11		Grading
Newhall	Aztec Oil Co., Sanborn	1	6, 3-16	7327	Idle
Puente	Barry Oil Co., Inc., Rowland	1	14, 2-10	2423	Pumping
	Melvin Hansen, Dragna	1	24, 2-10	3222	Drilling
	Lomi Oil Corp., John Rowland	1	14, 2-10		Material
Temescal	The Texas Co., Dominguez	57-1	1, 4-18		Grading
Whittier-La Habra	H. & C. Oil Co., Joyce	1	22, 2-11	5367	Drilling
	Los Nietos Valley O. Co., Woodward	1	29, 2-11	3600	Idle
	Orange County				
Costa Mesa	Carrey, A. A., Meyer	1	16, 6-10	1548	Drilling
Newport Beach	D. W. Elliott, Townsend	1	20, 6-10	2366	Completed
	San Bernardino County				
Carbon Canyon	Veta Grande Dev. Co., McDermott	2	5, 3-8	1184	Idle
Colton	Supreme Oil Co., Well	1	2, 2-4	940	Idle



This small scale rotary rig, built by Young Brothers of Signal Hill, is doing yeoman service on the A. A. Carrey Meyer No. 1 at Costa Mesa.

Working the unique rig shown above are: left to right—Tom Erskin—Les Roberts, driller—Frank Butler, welder—Ray Butler and Bror Olson.

The accompanying photos were taken on the prospector at a time when a control head was being installed to avoid trouble with gas which was encountered below a shell body at the 1245 ft. level. The wildcat was last reported drilling in the upper Miocene at 1548 ft.

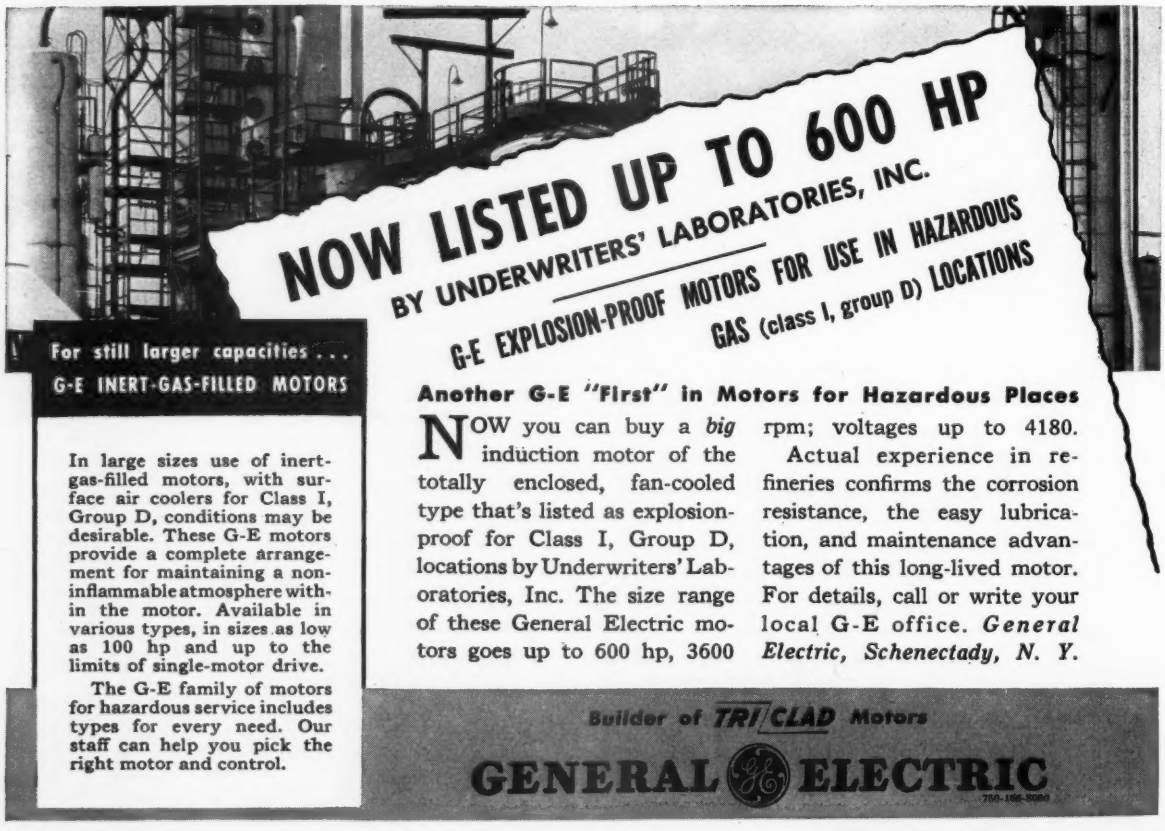
East Coyote Well Pumps

Graham Loftus Oil Corp. bottomed No. P-4 at 4364 ft. to complete pumping 110 bbls. of 18 gravity oil cutting 8% with one million feet of gas. Production at the end of the first week was 78 bbls. with the gas production halved and the cut increasing. The company's P-5 is drilling at 3246 ft. while foundation is in for No. 6.

On an offset location Severns Drilling Co., Ltd., is building rig for No. C-2 at a point 400 ft. north and 1621 ft. west of the southwest corner of the common section 13-3s-10w.

Killingsworths Try Turnbull Canyon Well

W. M. & M. T. Killingsworth are rigging pumping equipment in the old Axis Pet. Corp. Tandberg No. 1 on sec. 13-2s-11w in Turnbull Canyon. Located near La Mesita and Turnbull Canyon Roads at the northwesterly tip of the structure the well bottomed in hard black shale at 4189 ft. and plugged to 3440 ft. With 7 in. casing including 117 ft. of perforation landed at 3439 ft. and cemented through perforations at 3323 ft., the well swabbed and flowed oil and water. Line perforated 3330-3439 ft. the well then swabbed and flowed small heads of oil through a 32/64 in. bean. Knife perforated 3010-2940 ft. and gun perforated 3375-3430 ft. the well pumped 23 gravity oil at a 30 B/D rate which declined until the well was finally abandoned by Axis.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Coastal District

Los Olivos Well Makes Heavy Oil

Tide Water Assoc. Oil Co.'s second well in the Los Olivos district, Chamberlin No. 1 on sec. 33-8n-31w, which once produced heavy oil in what was considered insufficient volume at 4430 ft., deepened to 5194 ft. and completed on the pump with the assistance of injected distillate. Returns on the second day were 530 bbls. daily gross figures with an injection rate of 1¼ bbls. per hour. A small amount of free water was obtained with the oil. At last report the well was making a net 444 bbls. of 10.9 gravity oil. Next to start in the area will be Hub Oil Co. Bradley No. 1 in the southeast quarter of sec. 7-7n-30w.

Old Orcutt Well To Recomplete

Union Oil Co. is cleaning out to enter, redrill and recomplete Hartnell No. 1 which was drilled in 1904 near the center of sec. 23-9n-34w.

The well produced great elation in company breasts when it came in barefoot at 2780 ft. flowing 10,000 bbls. daily. Deepened to 2860 ft. in 1906 the well made 500 bbls. daily and produced until 1918 when casing was found collapsed at 1005 ft. and the well abandoned. It will be interesting to see what the old sands will produce with modern day drilling and production technique.

Coast Fields Remain Active

The San Miguelito-Padre Canyon -Rincon fields remain moderately active with a definite upbeat in numbers of jobs expected. At San Miguelito Continental Oil Co. continues its program with Grubb No. 2 redrilling at 6143 ft., No. 29 rigging up and location staked for No. 30. First to resume work at Padre Canyon is General Pet. Corp. which is plugging to redrill Padre No. 4 on sec. 15-3n-24w. C. C. M. O. Co. works at Rincon with Hobson No. B-10A recompleted pumping an average 35 bbls. daily and No. B-18 recompleted at plugged depth of 4280 ft. for a 155 bbl. return of 26 gravity oil flowing through a 20/64 in. bean.

On the Rincon pier Honolulu Oil Corp. is acidizing Whitten Permit No. 56-5 to better the 65 bbl. heading flow of clean oil which the try has been averaging from the upper sands in the interval 2685-2813 ft. Following established production in this zone the Miley will be tried from now packed off perforations in the interval 2952-3251 ft.

Northern Calif. Gassers Finished

Northern California gas reserves were materially boosted this week when Amerada finished Sacramento & San Joaquin Drainage District No. 3 at Rio Vista for 8,000,000 cu. ft. while Standard Oil Co. Andrus Island Unit No. 1 in the same field finished with a maximum flow of 11,987,000 cu. ft. through a 5/8 in. bean and Bankline Oil Co.'s Lodi area Community No. 1-1, sec. 1-4n--6e, finished at 2383 ft. flowing 8,050,000 cu. ft.

Santa Maria Valley Project Starting

Work in the Santa Maria Valley field will soon be increased for R.R. Bush Oil Co. has scheduled 14 new wells, Brain & Kohler is preparing to contract a new hole on the Rembusch lease at the southerly field flank while W. R. Gerard has already contracted for Acquistapace No. 2 in the southwest corner of sec. 22-10n-34w.

Already working is Bel-Air Oil Co.'s Twichell-Weging Comm. No. 1, sec. 35-10n-34w, which is making hole at 3481 ft. Continuing its already well established production program in the field Union Oil Co. completed Union Sugar No. 18 at

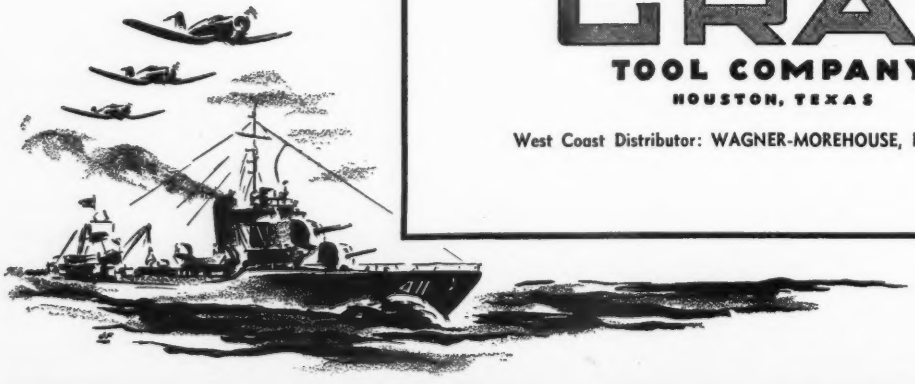
COASTAL COUNTIES WILDCATS

Area	Well	No.	Section	Depth	Status
	Santa Barbara County				
Gato Ridge	General Pet. Corp., Wickenden	2	24, 8-32	4819	Drilling
Lompoc	Alphonzo E. Bell Corp., Lompoc	6	28, 8-34	4997	Pumping
	Fickert Oil Co., Ltd., Well	1	8, 7-33		Rig
Los Olivos	Tide Water A. O. Co., Chamberlin	1	33, 8-31	5194	Pumping
Purisima Hills	Whittier Assoc., Barham	1	11, 7-32	528	Drilling
	Ventura County				
Bardsdale	San Marino Oil Co., Elkins	1	7, 3-19		Rig
Conejo	L. A. Basin Oil Co., Well	1	4, 1-20	1745	Swabbing
	Sycamore Oil Co., Boylan	1	23, 1-20	2747	Idle
Eureka Canyon	El. Rika Oil Co., Well	4	33, 4-18	254	Drilling
Piru	Continental Oil Co., Holser	2	14, 4-18	6732	Drilling
	Delroy Pet. Corp., Fisk, C. H.	3	22, 5-18	2808	Plugging
	Pac. West. O. Corp., Temescal	14	4, 4-18	4987	Drilling
	Standard Oil Co., Crestmont	1	14, 4-18		Cellar
	T.W.A. Oil Co., Hidden	2	5, 4-18	7731	Drilling
Rincon	Shell Oil Co., Inc., Tomson	1	8, 3-24	7400	Drilling
Santa Paula	J. J. Stevens, Corehole	1	1, 4-20	1500	Idle
Sespe	McCaslin, W. E., Burson	1	19, 4-19	2039	Idle
	Volunteer Pet. Co., Tar Creek	3	28, 5-19	540	Idle
South Mt.	F. E. Fairfield, S. M.	1	19, 3-20	2750	Rigging up
Timber Canyon	A. T. Dennison, Well	1	13, 4-21	2202	Bailing
	Crude Oils, Inc., West	1	19, 4-20	958	Idle
	Fletcher & Babcock, O'Leary	1	29, 4-20		Location

NORTHERN COUNTIES WILDCATS

County	Well	No.	Section	Depth	Status
Monterey	Columbia Oil Co., Vierra	1	7, 13s-2e		Rig
Sacramento	Amerada Pet. Corp., Capital Co.	1	36, 5n-5e	3209	Drilling
	Jergins Oil Co., McCormack	1	30, 5n-5e		Foundation
	Richfield Oil Corp., Natomas	1	17, 10n-4e	5030	Abandoned
	Richfield Oil Corp., Natomas	2	28, 10n-4e		Rigging up
San Joaquin	Amerada Pet. Corp., Lodi Comm.	8-1	8, 4n-7e	3000	Abandoned
	Bankline Oil Co., Comm.	1-1	1, 4n-16e	5765	Completed
	Bankline Oil Co., Comm.	2-1	12, 4n-6e	1818	Drilling
	Bankline Oil Co., Comm.	3-1	4, 4n-7e	1249	Drilling
San Luis Obispo	W'n Gulf Oil Co., Huasna Comm.	1	35, 31s-14e	3015	Abandoned
Solano	Amerada Pet. Corp., Starkey Fee	1	2, 6n-2e	9434	Idle
	Standard Oil Co., Honker	1A	25, 3n-1w		Location

THE FOOD OF A MECHANIZED ARMED FORCE IS OIL



As more mechanized weapons are made, calling for more fuel with which to keep them running, the problem of providing sufficient materials to produce both in adequate quantities becomes apparent.

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5275 ft. pumping a settled 192 bbls. of 16.9 gravity oil, is drilling No. 16 at 5200 ft. and is rigging up No. 17 while doing a production job on Bradley Lands No. 2-5 which sanded up after completing at 5085 ft.

Cat Canyon Well Turned To Tanks

Another substantial producer was credited to the Cat Canyon area when Union Oil Co.'s Bell No. 16, sec. 36-9n-33w, bottomed at 5517 ft. to complete for 961 bbls. in 14 hours flowing through a 1 in. bean. With bean reduced to a 20/64 in. opening the well made 864 bbls. of clean 18.3 gravity oil and approximately 200,000 cu. ft. of gas. On the same section the company's No. 17 is drilling at 1242 ft.

Pacific Western Oil Corp.'s Los Alamos No. 20, also in section 36, failed to flow after bottoming at 5900 ft. and was put on the pump for an as yet unestimated return. The company located No. 21 and is grading for No. 22 at a point 4805 ft. south and 335 ft. east of the northwest corner of Rancho Los Alamos.

To the east on sec. 32-9n-32w O. C. Field Gasoline Corp. spudded Williams No. 1 and is making hole at 1000 ft. after cementing surface casing at 400 ft.

Eureka Canyon Well in Pay

El Rika Oil Co.'s well No. 4 on sec. 33-4n-18w of Ventura county is coring typical shallow oil sands at 254 ft. after entering the main sand phases at 240 ft. In this area sands are found practically at the surface and the history has been small but profitable results to producers.

Piru Prospectors Continue at Depth

Activity in the Piru area is reflected by a series of relatively deep drillers. Deepest is Tide Water Assoc. Oil Co.'s Hidden No. 2, sec. 5-4n-18w, which is coring at 7731 ft. in hard gray sand and shells. Some faint cuts were noted in the cores near the bottom. Next in depth is Continental Oil Co.'s Holser No. 2 on section 14 of the township. This try is at 6732 ft. in hard shale showing steep dips. Oil sands have been cored at intervals below 4347 ft. where a production trial of upper showings resulted in small oil and mud returns with light gas showings. On the Temescal property Pacific Western Oil Corp.'s No. 14, formation data on which is witheld, is reported to be spot coring hard gray sand and shale at the 5000 ft. level

To the north on sec. 22-5n-18w, Delroy Pet. Corp. is plugging off bottom water at 2807 ft. in preparation for a series of gun perforations and production tests of sands cored at intervals below 2500 ft. Also planning to work the area is Standard Oil Co. which located Crestmont No. 1 for immediate drilling near the east quarter corner of sec. 14-4n-18w.

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D+B DIVISION

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Plants: LOS ANGELES, CALIFORNIA DALLAS, TEXAS

San Joaquin Valley

Richfield Starts Lost Hills Well

Richfield Oil Corp. is preparing to drill Lost Hills "A" No. 4(a) in the northeast quarter of sec. 5-27s-21e.

Only other active operator in the field is Universal Cons. Oil Co. which completed No. 55 at 1750 ft. on sec. 32-26s-21e, and No. 50 at 1711 ft. in the same section for small yields. Just finished on this lease was the company's No. 53 which is pumping 15 bbls. of 16 gravity oil from 1726 ft.

Elk Hills Worked By U. S. Navy

The United States Navy is developing its petroleum reserves in the Elk Hills. Four strings are currently working after having each finished one project. First completed was No. 85-2G on sec. 2-31s-24e which bottomed at plugged depth of 3070 ft. to pump 488 bbls. of clean 21 gravity oil. Others finished for substantial yield were Nos. 25-1G, 45-1G, 65-2G, 38-27S, and approximately 33 bbls. of water showing a little sand. The company is drilling No. 32A-26 in the same section at 1855 ft. in sandy clay after locating the oil zone in the interval 1050-1190 ft.

On section 20 of the area the Los Nietos Co. interests' Sheep Springs No. 1 is drilling ahead in hard brown Kreyenhagen shale at 4945 ft. Several sand phases showing oil have been found below 1065 ft. none of which on trial has shown commercial possibilities.

Second Mendota Well Flows Gas

The Texas Co.'s second Mendota area well, Gill No. 14-16 in sec. 16-13s-16e, duplicated the gas results of the first by flowing 10,600,000 cu. ft. on trial of the interval 4482-4501 ft. Cored to 4529 ft. three formation tests failed on oil sands in the interval 4510-20 ft. and 7 in. casing was cemented at 4509 ft. for further trial.

Antelope Hills Trv Cores Shows

E. B. Hall & Co.'s Theta No. 17-56, sec. 17-28s-20e, is coring oil stained and spotted silt at 831 ft. after finding the first showings at the 750 ft. level. 10¾ in. surface casing was cemented at 104 ft.

Honolulu Gets Cymric Pumper

Honolulu Oil Corp. completed No. 52-26, sec. 26-29s-21e, at 1297 ft. pumping 54 bbls. of 12.4 gravity oil

McVan Area Cats Seek Oil Traps

Two tests in the McVan area of Kern county seek oil entrapments capable of the heavy oil production so much in demand. Most likely to succeed is Pacific Western Oil Corp. Enas Fee No. 6, sec. 21-27s-27e, which is coring oily silt at 2090 ft. The other, Jergins oil Co. Lambert Lands No. 1 on sec. 35-26s-27e, appears doomed since at presstime it was coring gray sand at 3200 ft. after encountering the barren Vedder at 3020 ft.

Mt. View Wildcat Cores Basement

Di Giorgio Fruit Corp.'s fourth try in the Mountain View area entered basement at 5841 ft. and is plugging to test uphole after entering the rock only 4 ft. The test, located in sec. 10-31s-29e off the southerly tip of the field, cored fair oil sands at 5650 ft. which will be tried.

Tide Water To Try McLure Valley Area

Tide Water Assoc. Oil Co. poured foundation for Orchard No. 56 near the south quarter corner of sec. 30-24s-18e. The try is located southwest of the Company's No. 76 which drilled to an unfruitful 4329 ft. after entering the Cretaceous at 2375 ft. Some two miles to the northwest the company's West Slope well pro-

SAN JOAQUIN VALLEY WILDCATS

Area	Well	No.	Section	Depth	Status
	Fresno County				
Cantua Creek	Richfield Oil Corp., Cantua Co.	1	14, 17-15	5100	Abandoned
	Superior Oil Co., Cantua-Land	54-36	36, 17-15	10729	Abandoned
Chowchilla	Pure Oil Co., Gamboni	1	28, 10-13	4895	Drilling
Helm	G. P.-Pure Oil Co., Sopac	81-9	9, 17-17		Location
Guijarral Hills	Standard Oil Co., Well	62-29F	29, 20-16	8525	Drilling
	R. S. Lytle, Well	88-20F	20, 20-16	8433	Drilling
Wheatville	Superior Oil Co., Kreyenhagen	81-22	22, 17-18	9565	Drilling
	Kern County				
Antelope Hills	C.C.M.O. Co., Antelope Fee	12-1	12, 28-19	5001	Abandoned
	E. B. Hall Co., Theta	17-56	17, 28-20	831	Drilling
Belridge	Ernest F. Lang, Well	1	3, 28-20	2500	Suspended
Bowerbank	Albert Stevenson, Bowerbank	1	5, 29-24		Location
Comanche Point	T. W. Burnham, Chiquita	2	34, 12-19	2020	Prep. to deepen
Cymric	Los Nietos Co., Sheep Springs	1	20, 29-21	4945	Drilling
	Honolulu Oil Corp., Well	52	26, 29-21	1297	Completed
Dyer Creek	D. D. Dunlap, Dyer Creek	1	11, 26-27	2294	Pumping
Elk Hills	Pac. West'n & G.F. Getty, McNeil	1	22, 30-24		Location
Kern River	O. H. Calhoun, Bridge	1	17, 28-28		Location
McKittrick	Haddock, T. J. & J. E., Akern	1	24, 29-20		Prep. to spud
McVan	Jergins Oil Co., Lambert	1	35, 26-27	3240	Abandoning
	Pac. Western Oil Corp., Enas Fee	6	21, 27-27	2090	Drilling
Mt. View	DiGiorgio Fruit Corp., Well	4	10, 31-29	5845	Plugging
Round Mt.	Harp & Brown, Olcese	1	17, 28-29		Rigged up
	Palomar Ref. Co., Russell	1	6, 28-29		Rig
	Signal Pet. Co. of Calif., Mills	1	24, 28-28	2524	Abandoned
	Signal Pet. Co. of Calif., McGregor	1	26, 28-28		Rigging up
Strand	T.W.A.O. Co., KCL	76-8	8, 30-26	8370	Testing
	Kings County				
Hanford	The Texas Co., Souza	1	33, 17-22		Cellar
McLure	T.W.A.O. Co., Orchard	56-1	30, 24-18		Foundation
Tulare Lake	Shell Oil Co., Inc., T.S.G.	21-28	28, 22-20	11680	Drilling
	Madera County				
Mendota	The Texas Co., Gill	14-16	16, 13-16	4529	Testing
	San Luis Obispo County				
Midway, NW.	C.C.M.O. Co., Thomas	1	1, 31-21	9188	Abandoned
	Tulare County				
Terra Bella	Northern Ordnance, Inc., Campbell	1	22, 22-27		Location

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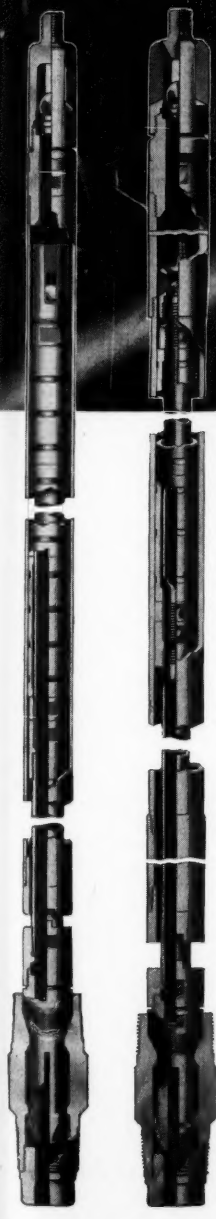

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Since the super-hard, one-piece barrels used in Flupaco "Improved Insert" and "Groove Seal" Pumps outwear many other pumps two to five times, it would seem only logical that such fine equipment would command premium prices. But Flupaco Pumps equipped with these barrels are available at prices corresponding to common multiple cast liner barrel types. Investigate today!

The unprecedented hardness measurements of Flupaco hardened and honed barrels (shown in the accompanying chart) account for the outstanding performance records of Flupaco Pumps.

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duced small amounts of 16 gravity oil in the Kreyenhagen from 849-941 ft. after prospecting to 2087 ft. in 1940.

Joint Test to Start at Helm

General Pet. Corp. and Pure Oil Co. are preparing to start a joint test in the Helm area of Fresno county. To be called Sopac No. 81-9 the well is located 330 ft. south and 330 ft. west of the northeast corner of sec. 9-17s-17e.

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Greeley Work Now Increased

Work in the deep Greeley field of Kern county is increased with four strings at work. At the extreme northerly tip of the field, adjacent to Rio Bravo production, Superior Oil Co. is drilling Lewis No. 3 at 1480 ft. near the north quarter corner of 29s-25e.

Standard Oil Co.'s KCL No. 11-37 is drilling at 10,175 ft. while No. 11-38 is standing with 13⅜ in. surface casing cemented on bottom at 1535 ft. The company's No. 12-6, sec. 30-29s-26e, is rigging up to sec. 12-29s-25e.

Levorsen to Address A. A. P. G. Meeting

Oil men in Southern California will soon have an opportunity to hear an address by one of the nation's outstanding petroleum geologists, A. I. Levorsen, Tulsa, Okla., past president of the American Association of Petroleum Geologists, and chairman of its Research Committee, will present a challenging paper, "Trends in Discovery Thinking." During peace times the oil industry has had an important place in the development of our industrial enterprise, and with the advent of highly mechanized warfare, the industry has redoubled its efforts to maintain oil reserves safely above demand.

All oil men are invited to be present at the California Club, 12 noon, Friday, May 21st, 1943, to hear the address by Mr. Levorsen.

Dud Hughes Now Marine Captain

M. D. "Dud" Hughes, former Chief Petroleum Engineer for Long Beach Oil Development Co., has been raised to the rank of Captain in the United States Marine Corps according to word received by his successor, S. T. "Spence" Taylor.

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Western Gear Works Appoints Crawshaw

An announcement has just been received from the Western Gear Works of the appointment of Mr. S. Leroy Crawshaw as Plant Manager of the Lynwood Plant. Mr. Crawshaw resigned from the Westinghouse Electric & Mfg. Co. to join the Western Gear organization after having served with Westinghouse for twenty-four years.

During his service with Westinghouse, he held positions of sales manager, sales representative at Dallas, Texas, applications engineer for Nuttall Works, advanced to the position of chief engineer of Nuttall Works and was later made manager of engineering—which job he held at the time of his resignation from the Westinghouse organization.

At Nuttall, Crawshaw helped develop gear drives for paper mills, oilfield applications of gears, etc., such as rotary counter-balanced crank for pumping units and speed reducers; sat in on the design and construction of the first roller bearing main gear drive for steel mills. During the preparedness program prior to the war he started Nuttall into heavy production of ship propulsion gears for C-1 and C-3 cargo ships for U. S. Maritime Commission. Incidentally, these gears use a quill arrangement patented by Crawshaw.

He is at present Chairman of the General Standards Committee of the American Gear Manufacturers Association of the United States.

Is a regular member of the American Society of Mechanical Engineers, American Society for Metals, American Society of Naval Architects and Marine Engineers, American Petroleum Institute and represents the American Gear Manufacturers Association on the Mechanical Standards Council of the American Standards Association.

Oil Workers are War Workers.

(Left) S. Leroy Crawshaw, newly appointed plant manager, Western Gear Works, Lynwood, California plant, examines blueprints with Max Peterson, facilities engineer of Western Gear Works.

Death Takes Reginald Kirchhoffer

R. B. "Berry" Kirchhoffer, one of the best loved business executives of southern California died on April 21st of a heart ailment at Good Samaritan Hospital. Born in Ontario, California March 28, 1896, raised and educated in Los Angeles, "Berry" Kirchhoffer had spent the last twenty-four years in the marketing end of the oil business with Standard Oil Company of California. As a local sales executive for that Company he enjoyed an extremely wide acquaintanceship.

An Ensign in the United States Navy in World War I, he entered the oil business in June 1919 as a service station salesman in Los Angeles. Advancing rapidly in oil marketing he was assigned to more important posts in Seattle and Oakland where he lived from 1924 to 1929. In 1929 he returned here and in 1933 was appointed Assistant District Sales Manager which post he held until his death.

For five years between 1935 and 1940 he was head of the Establishment Division of the Los Angeles Community Chest. He was a member of the Los Angeles Rotary Club, California Club, Los Angeles Country Club, American Legion Century Post No. 485, and the Wildcat Committee of the California Oil and Gas Association and was active in Los Angeles Chamber of Commerece and All-Year Club of Southern California work.

He is survived by his wife, Margaret Warner Kirchhoffer, whose two daughters are Mrs. H. E. Laughlin and Mrs. Gordon N. Topham.

Mr. Kirchhoffer lived at 712 North Linden Drive, Beverly Hills.

T.W.A. Employees Receive War Bonds

To insure that every employee of Tide Water Associated Oil Company now or hereafter on special leave of absence for military service in the United States armed forces shall own War Savings Bonds, that Company has adopted a policy whereby each such employee receives Series E War Savings Bonds of the aggregate face value at maturity of $150.00 Employees of the Company now in the active service of the armed forces, numbering approximately 1,200, are eligible for the benefits of this policy.

William F. Humphrey, President of Tide Water Associated Oil Company, is shown in the above picture presenting bonds to Lieutenant Lily Hutcheon, former secretary to the Company's Regional Counsel, and now in charge of procurement for the U. S. Marine Corps Women's Reserve, 12th Naval District. Yeoman 1st Class Edward J. Moon, who was employed in the Company's Credit Department prior to enlisting in the United States Navy, and who has just received his bonds from Mr. Humphrey, looks on smilingly.

Expressing the United States Treasury Department's approval of this patriotic policy of making War Savings Bonds available to employees in military service, is Willian F. Regan, Deputy Administrator, United States Treasury War Savings Staff for Northern California.

Tom Ferguson Passes Away

Thomas B. Ferguson, Field Superintendent for Herley-Kelley, passed away on April 21, 1943.

Mr. Ferguson was born in Woodville, Mississippi, in 1886 and came to California when he was 21 years old, and was first employed by the Mohawk Oil Company in the old Coalinga field. Later he became associated with California Petroleum, Dollar Oil Company and for the past six years has been in charge of all field operations for Herley-Kelley. Mr. Ferguson who has resided in Huntington Park for the past 13 years is survived by his wife Irma and son Jerome. Funeral services were conducted by Utter-McKinley in Huntington Park on April 24, 1943. Interment was private.

P.I.W.C. Recommends Tubular Goods Depots

Establishment of mill stocks and field depots of oil country tubular goods to eliminate present delays in obtaining pipe for drilling oil wells has been recommended to the Petroleum Administration for War and the War Production Board by the Petroleum Industry War Council, William R. Boyd, Jr., Council Chairman announced recently.

Oil-well drillers are experiencing long delays in shipments of pipe after government approval of purchases, and they no longer have any inventories of their own from which to draw. The War Production was asked to authorize establishment of stocks both at the mills and at field depots near centers of oil production, the stocks to be subject to control by the Petroleum Administration.

The Council also recommended to the Petroleum Administration that technical advisors be appointed for each district production committee, to help solve district problems of an engineering or technical nature, and as a group to discuss and correlate national problems with the Council's Committee on Production.

The production Committee's report, submitted to the Council with an accompanying report of the Division of Production of the Petroleum Administration, reviewed drilling operations in all five petroleum districts for the first two months of 1943, and discussed a number of production problems. These included secondary recovery, the appointment of technical advisors, a report of a study of the problem of obtaining sucker rods WPB Limitation Order L-211 freezing pipe manufacture, the establishment of tubular goods stocks, the manpower problem, the use of insignia for oil industry workers, and Executive Orders 9301 and 9240.

Climax Engineering Interests Buy McAlear Manufacturing Company

Ownership of McAlear Manufacturing Company, Chicago producer of valves, regulating and control equipment, was acquired by the interests controlling Climax Engineering Company, leading manufacturer of internal combustion engines, power units and generating sets, it was disclosed on April 22nd at the Climax home office in Clinton, Iowa.

Edward F. Deacon, Climax president, also will be president and general manager of the McAlear Company, it was stated in an announcement jointly issued by Mr. Deacon and Owen L. Coon, chairman of the board of General Finance Corporation, of which both companies are now subsidiaries. Mrs. P. G. McAlear, formerly president and now chairman of the board of the McAlear Company, will continue to be actively identified with the management.

Serve Similar Fields

Products manufactured by McAlear are widely used in the same fields served by Climax. In that connection Mr. Deacon expressed the opinion that this move would help both companies to broaden their service to customers in the oil industry and in the industrial and export fields

"Currently," Mr. Deacon pointed out, "both companies are substantially engaged in the production of essential war goods." On May 7, the Army-Navy "E" Award was conferred on Climax Engineering Company and its employes for high achievement in the production of war materials.

Vigorous Post War Plans

Each of the companies has broad post war plans, with new developments now in process awaiting only the releasing of manufacturing facilities by agencies of the Government.

"The important immediate result of this acquisition," Mr. Deacon indicated, "will be the supplementing of engineering talents of each company. This, plus economies of production and distribution, should accrue to the direct benefit of customers of both companies in the post war period."

McAlear products are employed in the oil industry and in maritime, industrial and synthetic rubber fields.

P.A.W. Issues Order No. 6

Use of material for secondary recovery operations by means of artificial water, gas, or air drive on any oil lease or property on which such operations were actually being conducted on March 30, 1943, was authorized on April 12th by the Petroleum Administration for War.

The authorization was contained in Supplementary Order No. 6 to Petroleum Administrative Order No. 11 and will continue in effect until June 30, 1943.

PAO No. 11 is the basic order governing the use of materials in petroleum production operations. It superseded Conservation Order M-68 of the War Production Board and differs from that order, so far as secondary recovery operations are concerned, in that it does not grant automatic authority for the use of materials in such operations.

As a result of the issuance of Supplementary Order No. 6, however, operators now will have approximately three months in which to secure clearance for the use of material in secondary recovery operations which will extend beyond June 30.

We have heard a lot of fish stories but this is the real McCoy. The biggest fish ever caught by rod and reel was a tiger shark, taken off Sydney Head, Australia, which weighed 1,382 pounds.

The staff of the Los Angeles office of The Cooper-Bessemer Corporation photographed at one of the rare times when John Rogers, Pacific Coast Manager and his assistants, could take time off the engineering jobs long enough to come into the office. Those photographed are: Seated—Left to right—Philip W. Mettling, Application Engineer; John Rogers, Pacific Coast Manager; Lucille Zalesky, Secretary; Standing—Left to Right—Thomas Kelly, Erecting Engineer; C. L. Moore, Research Engineer; Lloyd L. Jones, Chief Warehouseman; Conrad Rothermel, Warehouse Clerk. Walter Lake, erecting engineer, is the only one missing. Mr. Lake was on an important job in San Francisco.

McCarthy and O'Brien Open Offices

Geo. H. McCarthy and Jerome J. O'Brien have opened an office on the fifth floor of the Lane Mortgage Bldg., 208 W. 8th Street, Los Angeles, California, specializing as consultants in petroleum exploration and Management. Their services include the combination of geological exploration, petroleum engineering, property valuation and contract management of producing properties.

Mr. McCarthy is a graduate of the University of California and entered the oil business in 1920 in the geological department of the Amalgamated Oil Co. In 1923 he joined the Union Oil Co. as assistant to the Manager of lands. He entered the employ of the Tide-Water-Associated Oil Co. in 1933 as Asst. Petroleum Engineer of the Ventura Ave. field. In 1936 he was appointed Manager of Land and Production for the Sunset Oil Company. In this position he managed all the company's Production, Engineering, Geological and development operations in California, Texas, Oklahoma, Kansas, New Mexico and Montana. In October 1942, he resigned from the Sunset Oil Co. and accepted a position as General Manager of Franco Oils Ltd. and its subsidiary companies in Canada a position in which he is still active.

Mr. O'Brien is a graduate of the University of California at Los Angeles in Geology and the University of Southern California in Petroleum Engineering. His career in the petroleum business began as a junior engineer for the Martin Van Couvering organization of Los Angeles. He later joined the Sunset Oil Company as a member of a drilling crew to obtain actual field experience. A transfer was made from the drilling department to the production department of that company where he served as a roustabout, assistant warehouseman, production clerk and subsequently resident Engineer of the Long Beach Field. In 1937 he was transferred to Texas as resident Geologist and Petroleum Engineer for the Sunset Oil Company, with offices at Dallas, Texas. In 1938 he was appointed Superintendent of exploration and production for Texas operations with headquarters at Corpus Christi, Texas. In 1940 he was transferred to the head office of Sunset Oil Company in Los Angeles and appointed Chief Geologist. In addition to his exploration and development work in Texas and California, he has done extensive work in Oklahoma, Kansas, New Mexico, Montana and the Dominion of Canada. He is a member of the American Association of Petroleum Geologists, American Petroleum Institute and a registered Petroleum Engineer in the State of Texas.

Geo. H. McCarthy

Jerome J. O'Brien

In addition to general consulting, Petroleum Engineering and Geological work this firm will act as management contractors and as such perform all the duties of a production department including all the functions of the land, Petroleum Engineering, Geological and Exploration divisions.

This is not a new idea in the contract management of oil properties. The Union Pacific have operated very successfully and economically under a similar arrangement for several years. In the present time when the manpower shortage is acute and the supply of maintenance equipment limited, the most efficient management is necessary to recover the much needed oil.

Mr. L. C. Lamp, for the past seven years General Superintendent for the Sunset Oil Company will supervise the field activities.

S. C. M. A. Program For May Meeting

Mr. Randall Maass, chemical engineer for the General Petroleum Corporation, will be the featured speaker at the May 20th meeting of the Southern California Meter Association at the Rio Hondo Club. His subject will be "Aspects of Cycling Processes." Mr. Maass will give the reasons and necessity of cycling operations and the consequent behavior of compounds and mixtures. He will elaborate on gasoline recovery in expansion; recompression, refrigeration and absorption plants; and the necessary various pressure selections in pressure staging; on hydrates where they occur and where they cause difficulties, and the trend and type of conservation that is now of the greatest interest.

And besides! Hail! to all active, associate and sustaining members, for this is Past President's Night.

THIS LAUGH

OFF!!

Have you heard the one about the air raid warden who took advantage of the girl who was so dumb she didn't know anything about artificial respiration?

"Isn't Yvonne's new gown a perfect song?"

"Yes—sweet and low."

Customer: That stuff you sold me to grow hair is no good; look at those bumps on my head.

Druggist: (Looking at bottle) Great Scott! I've made a terrible mistake! That is bust developer.

Nowadays it seems that Peeping Toms are the only fellows who like retiring young ladies.

Baby pacifier: A bust in the mouth.

They say a kept woman wears mink all day and foxes all night.

One cigarette said to another: "I hope I don't get lit tonight and make an ash of myself."

"You look sweet enough to eat," he whispered soft and low.

"I do," the fair one answered, "Where do you want to go?

"I don't see how a woman can be happy without a husband."

"Well, just phone me some evening when you're without your husband and I'll come over and show you."

"They say you can tell a girl's character by her clothes."

"Oh, come now. Surely they have more character than that."

"My kid brother is only three and he can spell his name backwards."

"Remarkable. What is his name?"

"Otto."

"When you went to the seaside, did you keep your eyes open for a boy friend?"

"No. I closed one of them."

"Young man, my time is worth $100 a minute, but I believe I can give you a four-minute interview."

"Make it two minutes, sir, and I'll take cash for the balance."

They're rationing brassieres now. They take two points.

"Now what gives you the idea that I am a rustler?"

"Because you weren't around 10 minutes before you'd pinched one of my calves."

New Actor—I play the part of a married man.

Friend—Why don't you geta speaking part?

Preacher—All liquor should be thrown in the river.

Choir Singing—"Shall we gather at the river?"

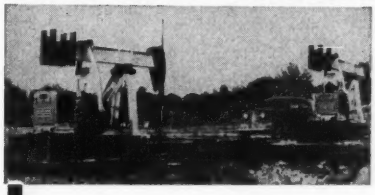
"At first it was love. He fascinated me—and I kissed him."

"Yeah, I know, and then he began to unfascinate you—and you slapped him."

Now that baby food is to be rationed, it is expected there will be a definite swing back to the original distribution plan from maker to consumer.

"I suppose you're still angry because I came home late last night with this black eye."

'Maybe you've forgotten, but when you came home, you didn't have that black eye."



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Promotion of Standard Oil Executives

Howard R. Cuyler, for the past year president of Standard Stations, Inc., has been appointed general sales manager of Standard Oil Company of California.

H. R. Cuyler

C. T. Furrer, until now a division manager of the parent company's marketing department, becomes the new president of Standard Stations, Inc.

In announcing the new appointment, T. S. Petersen, vice-president in charge of marketing, stated that Cuyler steps into the position made vacant some months ago when E. J. McClanahan became general manager of marketing, with jurisdiction over domestic operations and sales.

C. T. Furrer

Cuyler, a native San Franciscan, joined Standard of California in 1917 as a clerk. During World War I he served aboard the U. S. Navy Destroyer Schley. In 1931 he became Pasadena division manager of Standard Stations, Inc., and rose to the presidency in 1942.

Furrer's first position with Standard, after schooling at the University of Iowa, was at a service station in Portland in 1916. Except for a leave of absence to serve in the last war, he has been with the company ever since. He became Los Angeles division manager of Standard Stations in 1931. For the past seven years he has been at the office in San Francisco.

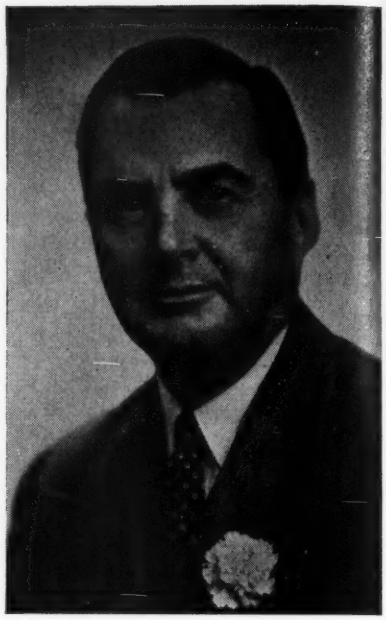
Standard Announces Promotions and New Butadiene Plant

Standard Oil of California expects to have a large butadiene plant completed and in operation early in September, it was disclosed on May 6 by President H. D. Collier at the company's annual stockholders' meeting held in San Francisco.

The new plant, first of its kind on the Pacific Coast, will produce the principal ingredient used in the manufacture of synthetic rubber.

All incumbent directors were unanimously re-elected at Thursday's meeting. Following the annual meeting the board of directors re-elected President Collier and all other officers. In addition, two new vice-presidents were elected. They are George J. O'Brien, heretofore assistant to the president, and now a vice-president resident in Los Angeles, and E. J. McClanahan, general manager of marketing, who becomes vice-president in charge of domestic marketing.

The complete board of directors is composed of H. D. Collier, R. C. Stoner, J. L. Hanna, J. H. MacGaregill, F. S. Bryant, R. G. Follis, Atholl McBean, A. N. Kemp and T. S. Petersen.



George J. O'Brien
(now Vice President)

O'Brien and McClanahan are both longtime employees of Standard of California. O'Brien, a native of San Diego, was graduated from the University of California. A naval ensign in World War I he became a regular employee of Standard in 1920. He was treasurer before going to Los Angeles as assistant to the president.

McClanahan spent most of his career to date in the sales department and for some time was president of Standard Stations, Inc.

Fred Hubler With Army

Fred W. Hubler, associated with Petroleum Rectifying Co., Tretolite Co., and the Dehydro Company as Advertising Manager, was formally inducted into the Army on May 10.

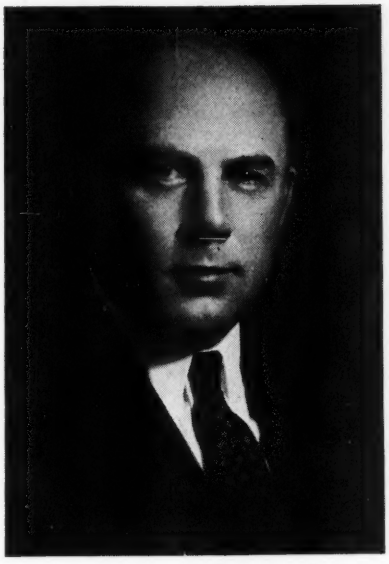
Mr. Hubler has been assigned to the 940th Engineering Aviation Camouflage Battalion for preliminary training. Well known to the oil fraternity since his graduation from Stanford in 1931, Mr. Hubler's friends in the Mid-continent and California join in wishing him the best of luck.

N.G.A.A. Meeting in Dallas Conforms to War Time Demands on Natural Gasoline Industry

Greater use of facilities of the natural gasoline industry for the increased output of available products readily convertible into war material such as fighting grade aviation gasoline and synthetic rubber raw materials by catalytic, cracking, polymerization or other processing, was the keynote of the 22nd Annual Meeting of the Natural Gasoline Association of America in Dallas, Texas April 14-16 attended by George L. Tyler, secretary of California Natural Gasoline Association.

The meeting, rightly called a War Products and Process Convention, fully justified the attendance of more than 400 men from mid-continent and other oil producing areas. Leaders in the natural gas and gasoline research fields were there to describe the most advanced ideas in natural gasoline plant design, operation and laboratory methods with the dominant thought in mind of utilizing natural gas and natural gasoline and used equipment in furtherance of the war effort. The importance of iso butane and iso pentane production for conversion into aviation fuel was stressed in a paper by Bruce K. Brown, assistant deputy petroleum administrator of PAW which was read by Col. Jacques Morrell. Therein it was pointed out that one barrel of iso butane can be converted into four barrels of 100 octane gasoline through processing. Plant changes should be submitted to the Natural Gas and Gasoline Division of PAW which will consider a potential output of 60 to 70 barrels a day of iso butane production as sufficient to warrant an installation. Time required for the change and the amount of critical materials involved will, of course, be a factor in the fixing of priorities.

The trend to pressure maintenance and the unitization of condensate fields was emphasized in a description of the experiences in the



Geo. L. Tyler
(Attends Dallas Meeting)

Tepetate and Cotton Valley fields in Louisiana.

Elected as president of Natural Gasoline Association of America for the ensuing year was J. W. Vaiden of Skelly Oil Company, who has been active in the affairs of that Association for many years. Announcement was made that Franklin P. Peterson, retired assistant manager of production for the Mid-Continent Petroleum Corporation, had been nominated as the recipient of the Hanlon Award for this year. This award is made annually to an individual who has made some outstanding contribution to the natural gasoline industry. Mr. Peterson was a pioneer in the development of liquefied petroleum gas production and markets in the East and Midwest. It is recalled that Alois Kremser of the Standard Oil Company of California was recipient of the Award in 1941 for his fundamental treatise on absorption factors.

Due to differences in location, the problems of the natural gasoline industry in the mid-continent and of those in California are unlike in many respects, but the standardization work of the Natural Gasoline Association of America and of the California Natural Gasoline Association is continuing with an increasing exchange of ideas, data and results which gradually are making for more uniform methods of operation, specifications and tests for the industry throughout the country.

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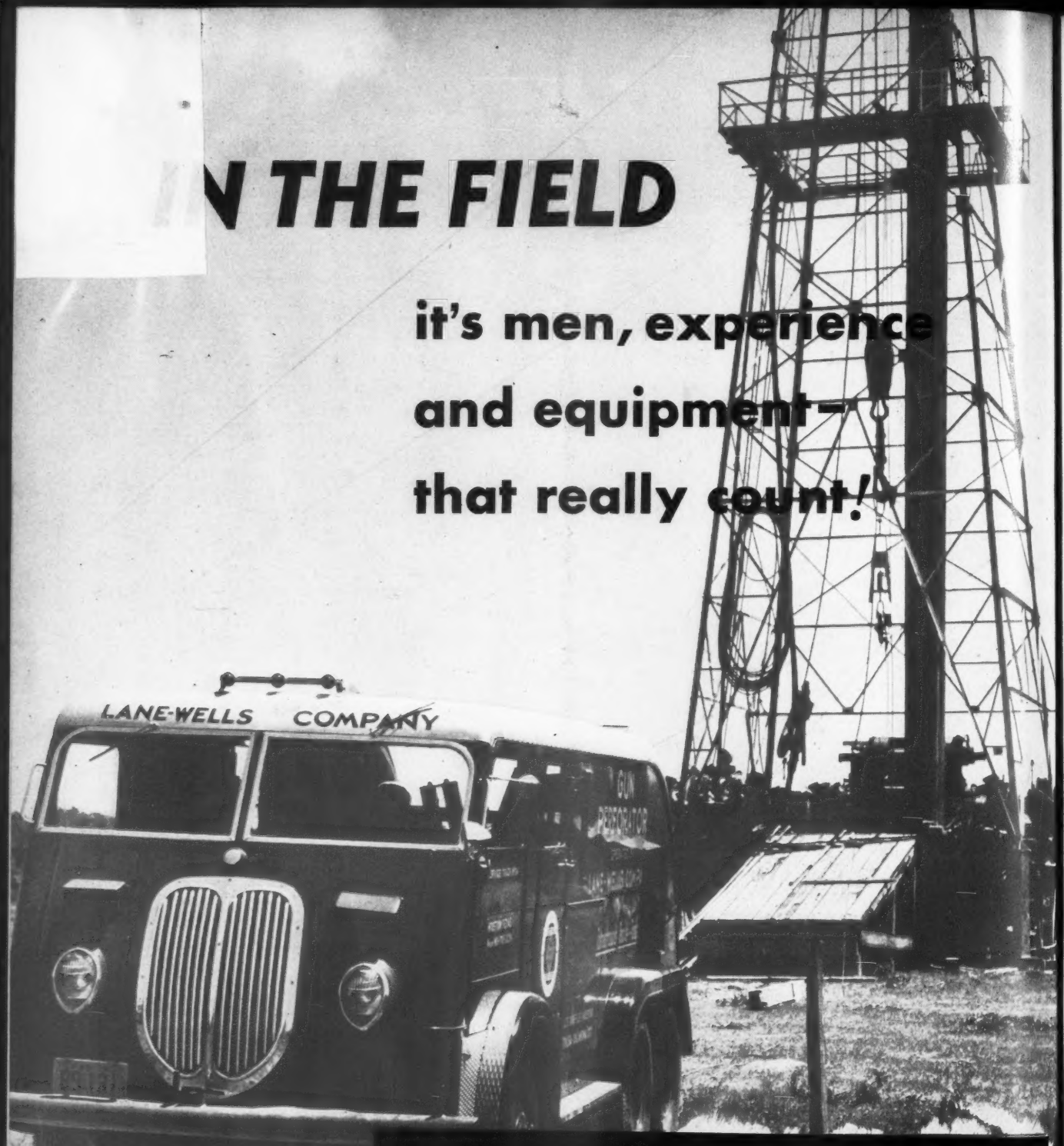
"Have you noticed how a women lowers her voice whenever she asks for anything?"

"Oh, yes, but have you noticed how she raises it if she doesn't get it?"



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